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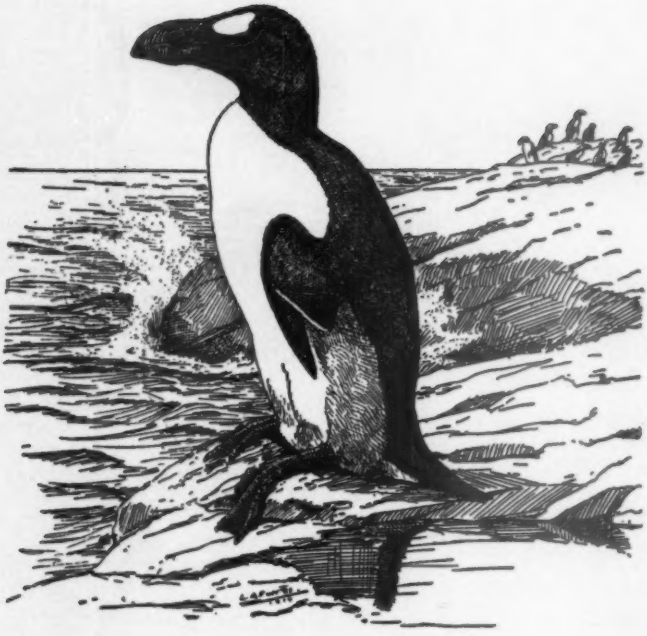

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THE AUK

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ADAPTATIONS FOR FOOD-GETTING IN THE AMERICAN BLACKBIRDS

BY WILLIAM J. BEECHER

A careful study of the American blackbird family (Icteridae) during the past several years reveals that its members have invaded virtually every food niche exploited by passerine birds. The present investigation of the functional modifications of skull, bill, and jaw musculature in the 38 genera suggests that this success stems initially from a general pre-adaptation permitting an entirely new method of feeding. This paper describes first the individual feeding adaptations, then their convergent re-appearance in each of the three major icterid lines. Although the graphic comparison of the genera is presented in the form of a morphological tree of relationships in Figures 7 to 10, the full evidence for these relationships is not offered here. The present paper confines itself rather strictly to the nature of the adaptations themselves.

METHODS AND MATERIAL

Primarily, the method of investigation has been one of attempting to establish valid correlations between skull structure and known feeding functions in the various genera. The diet of North American species was determined from the stomach analyses made by the Biological Survey under such men as Judd, Beal, and McAtee (1900–1910). For Central and South American species the field notes of Wetmore (1916, 1926), Wetmore and Swales (1931), and a few other careful observers were invaluable. Functionally, the method of feeding is of even greater importance than the kind of food taken, and very close observation of birds in field and captivity has been necessary. I am deeply indebted to its designer, Mr. Victor Carbonara, for the use of a Sard 6x 20 binocular, invaluable at ranges down to four feet. Due to its closely approximated objectives, I have been able to interpose a large magnifying lens and use this glass at extremely close ranges

with magnifications up to 18. Dissection and drawing of jaw musculature were done under a binocular dissecting microscope not generally exceeding a magnification of 18 times.

For the anatomical specimens and skulls used I am indebted to the United States National Museum, Museum of Vertebrate Zoology, American Museum of Natural History, and particularly to the Chicago Natural History Museum. For the free use of specimens in their care or for advice, I wish to thank Alexander Wetmore, Herbert Friedmann, Frank A. Pitelka, John T. Zimmer, Ernst Mayr, Dean Amadon, Emmet R. Blake, Karl P. Schmidt, and, especially, D. Dwight Davis.

Architecture and Mechanics of the Passerine Skull

The bird skull is as remarkable a structure from the engineering standpoint as exists in nature. Vertebrates, generally, are characterized by *akinetic* skulls in which the pterygoids, palatines, and quadrate are immovably fused with the cranium. The skulls of birds and most reptiles, however, are *kinetic*—a term which expresses the fact that the palato-pterygoid framework is movable with respect to the cranial part of the skull. Resemblance between birds and reptiles ends here for they are functionally very different. As regards birds, the importance of this type of skull is not generally appreciated despite the papers of Moller (1931) and Engels (1940). In fact, no real understanding of the manner in which birds eat is possible without a grasp of the simple mechanism of the kinetic skull.

Movement is readily restored to a dried skull by boiling it a minute or two in water. It will then be seen that the upper mandible may be moved up and down on its articulation with the cranial part of the skull—the naso-frontal hinge (Fig. 1)—and that this movement of the bill is communicated by an articulated series of rod-like elements to a quadrate bone on either side of the skull. These elements are the palatines and pterygoids, which slide along the sphenoidal rostrum medially, and the jugal bars which connect the bill with the quadrate laterally.

Actually, of course, the musculature initiating these movements works the other way around. The quadrate occupies a key position. The muscle that originates on the medial surface of the jaw and inserts on the apex of the long, lever-like orbital process (*f*) of the quadrate pulls the lever down when it contracts (Fig. 1, *Retracted*). This rocks the quadrate backward on its articulation with the cranium, setting up a powerful drag on the rod-like jugal bones laterally and on the pterygoid and palatine bones medially. Since these all connect

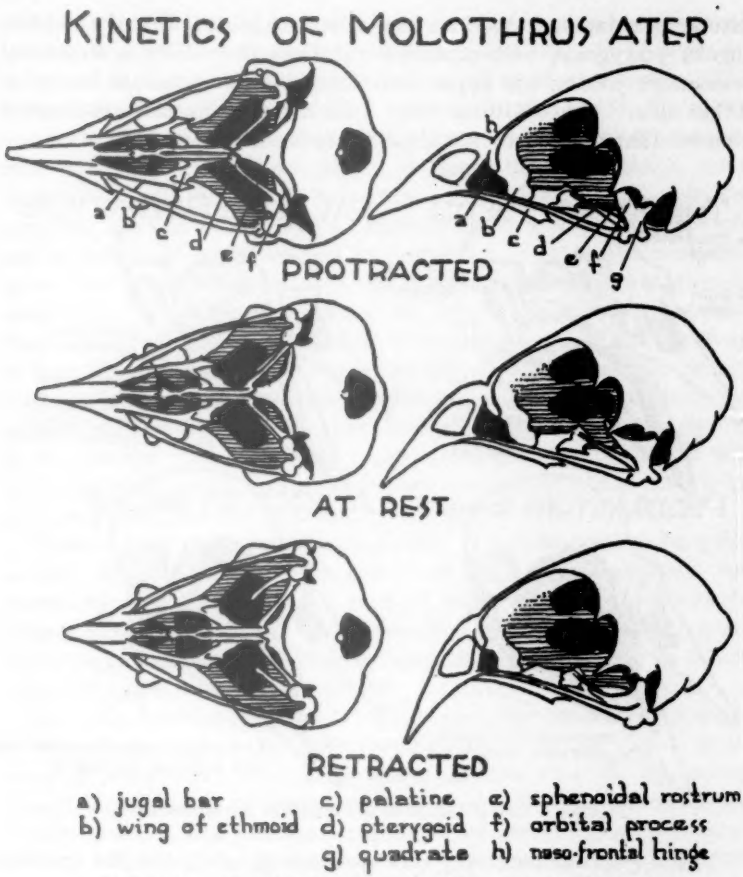

FIGURE 1. Skull kinetics in the Cowbird, *Molothrus ater*.

with the base of the upper mandible, this drag, acting on the naso-frontal hinge (*h*), is translated into a down-swinging of the tip of the mandible, which terminates in its retracted state. Protraction is accomplished by a reversal of these movements. The muscle whose contraction rocks the quadrate forward does not insert on the orbital process but on the quadrate body and on the pterygoid at its junction with the quadrate. Since its origin is at the postero-internal angle of the orbit, contraction produces an upward pull and a resultant forward rocking of the quadrate. This delivers a powerful thrust upon the rod system which, at the base of the upper mandible, is translated

into an upswinging of its tip. It will be seen (Fig. 1) that the rod-like jugals, pterygoids, and expanded palatines thus form a structural framework joining the upper mandible with the quadrate bones on either side. The palatines (Fig. 2 *E*) together form an enclasping element that slides smoothly along the sphenoidal rostrum.

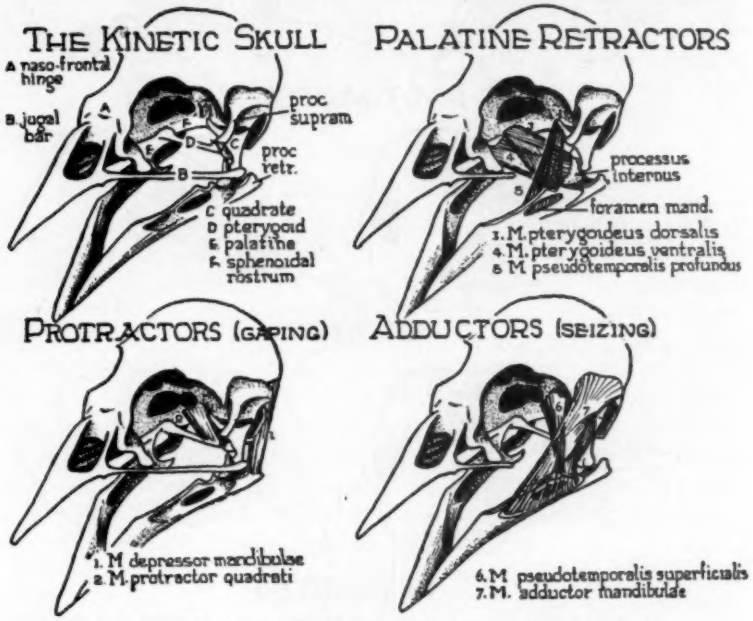

FIGURE 2. Mass functions of muscles in the kinetic skull.

This appears to be a very elaborate arrangement, and the question arises just why a kinetic upper mandible is necessary. When the lower mandible is in place (Fig. 2), its condyle articulating with the head of the quadrate, a remarkable co-ordination of the musculature operating this mechanical system is possible. In general the upper mandible is protracted only when the lower mandible is depressed, and lowered whenever the lower mandible is raised. Of course this is an effective means of increasing the gape, but Moller's (1931: 139) explanation of kinetics as a means of preserving the axis of the bill, especially in long-billed forms, is probably the primary one. The inefficiency of an akinetic bill may be compared to that of a thumb and forefinger in which the latter is immovably fused to the hand. The axis of the bill would change with the degree of gape if the upper

mandible were not movable, and this would be hardest on insectivorous species required to snatch their prey very quickly. It is precisely these forms that have the highest degree of skull movement. The jaw musculature appears confusing when fully labelled (Fig. 4) partly due to Lakjer's (1926) admirable job of homologizing avian musculature with that of the Sauropsida. It might be, for instance, more desirable to call the muscle that retracts the quadrate, *M. retractor quadrati*, but this muscle had a different function in avian ancestors and is called *M. pseudotemporalis profundus*. One might prefer to speak of *M. temporalis*, but it is not homologous with that muscle in mammals. The sauropsid term is *M. adductor mandibulae externus superficialis* and it is as indestructible under the concept of homology as any trinomial name. Fortunately this difficulty may be largely avoided in comparing muscle modifications between species; the muscles varying in development are relatively few and may be referred to by number. The simplified musculature given at this point will deal only with muscle groups—not their component parts—and with these according to their function.

These muscle groups so classified (Fig. 2) will be seen to be quite simple. There are only seven and these are broken down into the *protractors* which increase the gape of the mandibles, the *palatine retractors* which draw the upper mandible downward and to some extent raise the lower mandible to meet it, and the *adductors* which powerfully raise the lower mandible.

Under the heading *protractors* it will be seen that there is but a single muscle for depressing the lower mandible on each side. This is *M. depressor mandibulae* (Fig. 2, *1*) which originates on the squamosal area of the cranium and inserts on the *processus internus* and *processus retroarticularis* at the posterior end of the mandible. Similarly, there is but a single muscle for elevating the upper mandible. This is *M. protractor quadrati* (*2*), originating in the postero-internal angle of the orbit and inserting both on the body of the quadrate and on the head of the pterygoid where it articulates with the quadrate.

The *palatine retractors* are three in number. The principal function of this group is to draw the tip of the upper mandible downward but, since the muscles insert on either the inner surface of the lower mandible or on its internal process, they tend at the same time to draw the lower mandible upward. *M. pseudotemporalis profundus* (*5*) initiates these movements, acting on the lever-like orbital process of the quadrate. Its insertion is on the tip of the process and its origin is on the inner surface of the mandibular ramus, actually the lower margin of the mandibular foramen. The *M. pterygoideus dorsalis* (*3*)

arises just posterior to the junction of the palatines with the pterygoids on the posterior extension of the palatines and inserts on the internal process of the mandible. The *M. pterygoideus ventralis* (*4*) originates on the surfaces of the palatine and inserts both on the internal process and on the inner surface of the mandible far posteriorly.

Finally, the adductors of the mandible perform the sole function of powerfully elevating the lower mandible and bringing it into contact with the depressed upper mandible for seizing prey, cracking seeds, etc. The *M. pseudotemporalis superficialis* (*6*) is the medial of these two muscle masses. It originates on the posterior wall of the orbit and generally inserts on the medial dorsal surface of the mandible far posteriorly, though in certain finches and "near-finches" the insertion advances anteriorly. By alternate contraction of this muscle on either side, the lower mandible may then be shifted from side to side against the upper in hulling seeds. Additional adducting power is also gained by this forward advance of the insertion. The *M. adductor mandibulae* (*7*) is the very large adductor mass originating in the temporal fossa, on the suprameatic process, and on the quadrate, and inserting on the dorsal and lateral surfaces of the mandible.

This discussion, as well as the diagrams in Figure 2, is much oversimplified. The detail drawing of the muscle pattern of the Cowbird, *Molothrus ater*, in Figure 4 indicates that the discussion must be broken down further for purposes of comparison with other species of the family. There are still seven muscle masses having the functions ascribed above; they are treated individually and referred to as (*7a*), (*7b*), etc. Some of the muscles might be detailed still further, as for example, *M. depressor mandibulae* (*1*). But this would serve no useful purpose and the anatomical picture will be kept as simple as possible.

Nature of the Modifications for Feeding

The nature of feeding modifications in both skull and jaw musculature is best studied in a family whose boundaries are rather well agreed upon by ornithologists. Such a family is the Icteridae—and it is especially satisfactory because its species run virtually the entire gamut of food adaptations, with correspondingly great variations in bill and skull. Friedmann (1929) has expressed the opinion, based on extensive work, that the Cowbird, *Molothrus*, is the most primitive member of the Icteridae. There is abundant evidence that the entire family originated from a finch ancestor; the persistence of the angulated commissure in all forms seems significant, to mention a single point. My own anatomical studies (unpublished) of several hundred

passerine species point to the emberizine finch *Phrygilus* as being close to the ancestor from which the Cowbirds spring—and *Molothrus* itself is in many structural respects a finch. It might be stated, therefore, that this family has secondarily embraced many other food niches (additional to the seed niche) by an elongation of the bill and the skull and muscle changes that have accompanied it.

Adaptations for Seed-cracking and Insect-eating.—The changes occurring between thick-billed and slender-billed genera were investi-

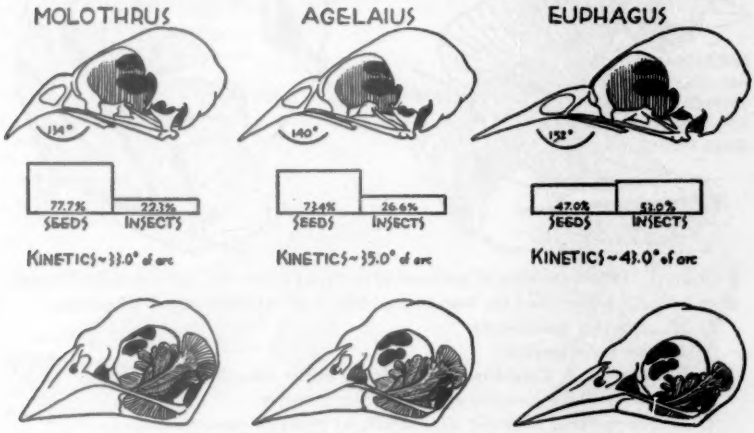

FIGURE 3. Adaptive modifications of the skull with change in diet.

gated first, emphasis naturally falling on correlations between structure and food habits. The food analyses made by Judd, Beal, and McAtee (1900 to 1910) were broken down to show the relative percentage of vegetable and animal material taken by each species (essentially seeds and insects). Features conspicuously varying with diet were the mass and length of the bill, degree of angulation of the commissure, length of the orbital process of the quadrate, and the degree of kinetics. A special device for measuring the latter included an adjustable plexiglas clamp for holding the cranial part of the skull rigid while the upper mandible was manipulated.

It was found that the finch-like Cowbird has an annual diet averaging 77.7 per cent seeds and 22.3 per cent insects (Fig. 3). Correlated with this is a short, massive bill with a highly angulated commissure (134°), reduced kinetics (33° of arc), a quadrate with the lever-like orbital process much elongate, and a palatine foramen relatively far posterior. The Red-winged Blackbird, *Agelaius phoeniceus*, and the Rusty Blackbird, *Euphagus carolinus*, are progressively more insectiv-

orous in their annual diet (26.6 per cent for the former, and 53.0 per cent for the latter). Correlated with this, movement in the skull is progressively increased (35.0° in *Agelaius*, 43.0° in *Euphagus*), the angulation of the commissure is decreased (140° in *Agelaius*, 152° in *Euphagus*), and the bill is elongated. At the same time the palatine foramen advances forward, and the bill becomes less massive and more

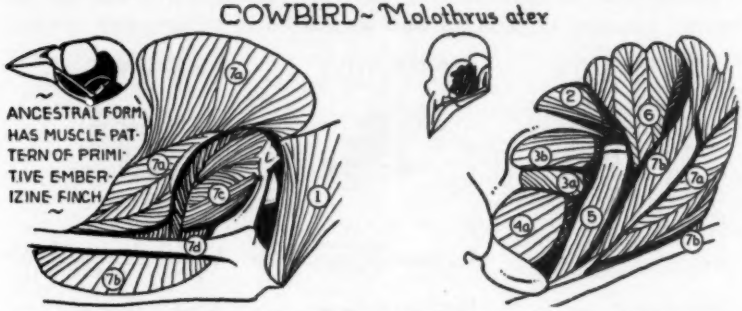

FIGURE 4. Detail drawing of jaw muscle pattern of Cowbird (ancestral finch type).
Protractors. 1 depresses the lower mandible; 2 elevates the upper mandible.
1. *M. depressor mandibulae*
2. *M. protractor quadrati*

Palatine retractors. Combined action draws upper mandible downward.
3. *M. pterygoideus dorsalis:* a) *anterior;* b) *posterior*
4. *M. pterygoideus ventralis:* a) *anterior;* b) *posterior* (underlies a)
5. *M. pseudotemporalis profundus*

Mandibular adductors. Combined action draws lower mandible upward.
6. *M. pseudotemporalis superficialis*
7. *M. adductor mandibulae:* a) *externus superficialis;* b) *externus medialis;* c) *externus profundus;* d) *posterior*

forceps-like. Finally, the orbital process of the quadrate becomes shorter. These are, then, skull changes accompanying a more insectivorous diet.

Before carrying the picture of adaptational changes with insectivorous diet into the musculature, it is necessary to call attention to the two basic types of skeletal muscle, pinnate and parallel (Pfuhl, 1936). The parallel type has all the fibers running the full length of the muscle and exerting pull, upon contraction, directly between the points of attachment (Fig. 4, *5*); the entire jaw musculature of primary insect-eaters like the muscicapids is parallel. The pinnate type is one in which the tendon or raphe runs the length of the muscle, and the short fibers originate from it as the barbs originate from the shaft of a feather (Fig. 4, *6*, *7*). Grant (1942: 384) puts the essential difference between the two clearly: ". . . a pinnate muscle has shorter fibers but

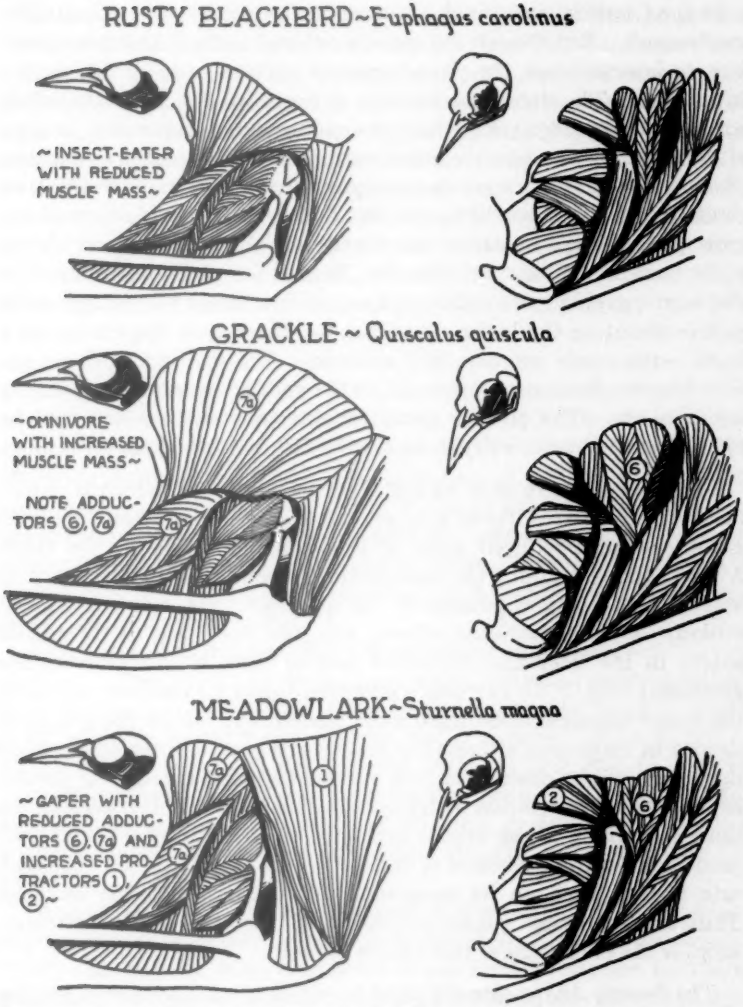

FIGURE 5. Detail drawings of basic icterid muscle pattern showing adaptive modifications in various genera.

a much greater functional cross section for its bulk than a parallel muscle. In other words its pull will be shorter but more powerful." Certain advanced groups of birds have converted the mandibular adductors from parallel to pinnate. The finch groups have done so, and the similar arrangement in the Icteridae further supports the view that this is a finch group secondarily invading other food niches.

In the Cowbird, as in finches generally, the adductor mass is greatly emphasized. But though the mass is reduced as finch character gives way to insectivorous, the pinnate muscle pattern basic to this family is not lost. The decreased kinetics of the finch-like *Molothrus* skull indicates that seed-cracking does not require as wide a spread or gape of the mandibles as does the insect-eating most prevalent in *Euphagus*. *Molothrus*, therefore, appears to require a short but powerful pull in elevating its lower mandible, and this is provided by adductors of the most pinnate type in which the fibers meet the tendon at an obtuse angle (around 45°) and are thus the shortest found in the family. In *Euphagus*, gaping more widely and requiring a longer but less powerful pull in elevating the lower mandible, the fibers meet the tendon at a more acute angle (around 35°, average). The individual fibers are thus longer—the nearest approach to the parallel adductors of primary insect-eaters. The pinnate character due to finch ancestry may be too deep-seated genetically to be readily lost in a food adaptation.

These features are best seen in Figures 4 and 5 in which it is also more apparent that there is a general reduction in muscle mass in *Euphagus*, with reduced areas of origin and insertion on the skull. A final point concerning the musculature is associated with the varying length of the orbital process of the quadrate. As was pointed out initially this is essentially a lever, and the mere fact of its greater length in the finch-like *Molothrus* insures that *M. pseudotemporalis profundus* (Fig. 2, *5*), exerting a downward drag on its apex, will draw the upper mandible downward more powerfully. Since the process is shorter in *Euphagus*, a muscle of exactly the same size would draw the upper mandible downward less powerfully but through a greater angle of arc in correlation with its greater kinetics. This is because the same shortening of the muscle acting on a shorter orbital process will produce a greater excursion of the tip of this lever and rock the quadrate farther back on its squamosal articulation with the cranium. Thus, lever-mechanics alone may solve this problem, and it is unnecessary for the finch to have this muscle pinnate.

The Sawing Adaptation of Grackles.—Since it involves strong emphasis on the adductor mass (Fig. 2) as noted in the Cowbird, the sawing adaptation of the northern grackles, *Quiscalus*, is discussed next. At first glance the powerful development of *M. adductor mandibulae externus superficialis* (Fig. 5, *7a*) seems incongruous in a species whose bill is not nearly as thick and conical as that of a finch. But it can be shown that this adductor mass has the same rôle functionally as in the finch-like Cowbird.

Wetmore (1919) was the first to describe the hard keel projecting downward from the horny palate in the Bronzed and Purple grackles, *Quiscalus*. Sharper and more abrupt anteriorly, this keel extends well below the level of the tomium and is used in a sawing adaptation described by Wetmore and later by Schorger (1941). As Wetmore pointed out, these birds habitually crack acorns by means of this tool—the nuts being scored completely around the shorter diameter, then cracked by powerful adduction. Wetmore also mentioned the cracking of kernels of dried corn, and I have witnessed this in detail with captive birds, using the Sard binoculars at the very close range of four feet. The kernel is oriented longitudinally against the keel by means of the tongue and there follows a persistent chewing or repeated powerful adduction lasting fully a minute. When the kernel is broken in two, one of the halves is oriented crosswise against the keel and champing continues until it has been broken up small enough to swallow. Captive grackles do this even when food trays are well-stocked with small fragments of cracked corn, and it may simply be an additional form of energy release indulged in by caged birds. Although a single muscle has been emphasized above to demonstrate powerful adduction in this genus, the entire adductor and retractor masses (Figs. 2 and 5, muscles *3*, *4*, *6*, and *7*) are very strongly developed, just as in finches.

Wetmore found this keel fully developed in the young bird by the first fall. Also, adults of the northern races, *Quiscalus q. quiscula* and *Q. q. aeneus*, collected in late fall and early spring had the keel much worn, while the southern race, *aglaeus*, had it unworn. Since *Cassidix*, quite likely on the direct line evolving *Quiscalus* (Fig. 9), has the keel undeveloped as a cutting tool, it appears that the development of a keel in *Quiscalus* may be an adaptation adjusting grackles for life in the northern states when this region has been deserted for lack of food by all but "winter-adapted" species.

This is a remarkable adaptation because it seems to be clearly superimposed, as is the similar adaptation in the oriole, *I. gularis* (Wetmore, 1919). In keeping with their omnivorous food habits the northern grackles have a bill structure resembling that of crows. However, the addition of a sharp palatal keel, by specialization of a palatal boss, present in nearly all blackbirds as a primitive feature, and the strengthening of the adductor musculature permit them to exploit a new food niche. This offers some insight into the origin of new adaptations related to feeding. Like other blackbirds, grackles are "resourceful," continually trying new feeding methods. I have seen them picking dead minnows from the surface of a pond (*cf.* Richardson, 1947) and, although performed awkwardly, this is the kind of feat that selection

pressure could seize upon and perfect, were it sufficiently advantageous.

The skull of this genus seems to present a clear compromise, re-embracing features of finch ancestors while remaining generalized—and compromises are frequently not successful in nature against the competition of neighbors specialized for a single food type. Finally, I am informed that Mrs. Laskey has discovered that a captive young Bronzed Grackle gapes in the manner to be described for the next genus. This is something I have not yet observed and it places the northern grackles at the head of the list, so far as adaptations for food in this family are concerned.

The Gaping Adaptation of the Meadowlark.—A conspicuous feature in the skull of the Meadowlark, *Sturnella magna*, is the great development of the muscles of protraction (Fig. 2). The muscle for elevating the upper mandible, *M. protractor quadrati* (Fig. 5, *2*) is not ordinarily a powerful muscle in birds. The muscle for lowering the lower mandible, *M. depressor mandibulae* (Fig. 5, *1*), is not powerful in any vertebrates which ordinarily open the mouth only to close it on something. Both of these muscles have become very powerful in the Meadowlark, seemingly at the expense of the adductors which are unusually small; and this is correlated with the method of feeding. These birds drive the closed bill into the ground and open it powerfully against the resistance of the earth. The degree of this adaptation is most evident when one examines the *processus retroarticularis*, the posterior extension of the mandible seen in Figures 2 and 5, upon which *M. depressor mandibulae* acts as a powerful lever. Dr. Wetmore first called my attention to this process and his understanding of its significance is clear from his description (1926: 378) of the earth-probing adaptation in *Amblyramphus*.

Full realization of the bill as a tool in birds, whose forelimbs have become useless as feeding tools through their modification for flight, is achieved in the Meadowlark. Its foraging in short grass, exactly like that of foraging starlings, consists in a repeated, spasmodic opening of the mandibles for the purpose of clearing the area at the roots of the grass for an unobstructed view. This is an extraordinary behavior to watch. A captive European Starling may gape in its food pan with such precision as to roll away a single grain at a time to disclose what lies underneath. A captive Meadowlark raised by Mrs. Nice gapes constantly in exploring its environment, and the significance of this instinct as related to the normal life of the wild bird seems evident; it will insert the closed bill into any small hole in fabric or paper and attempt to enlarge it. It must be added, in view of the widespread impression that the eyes of birds are incapable of much movement in

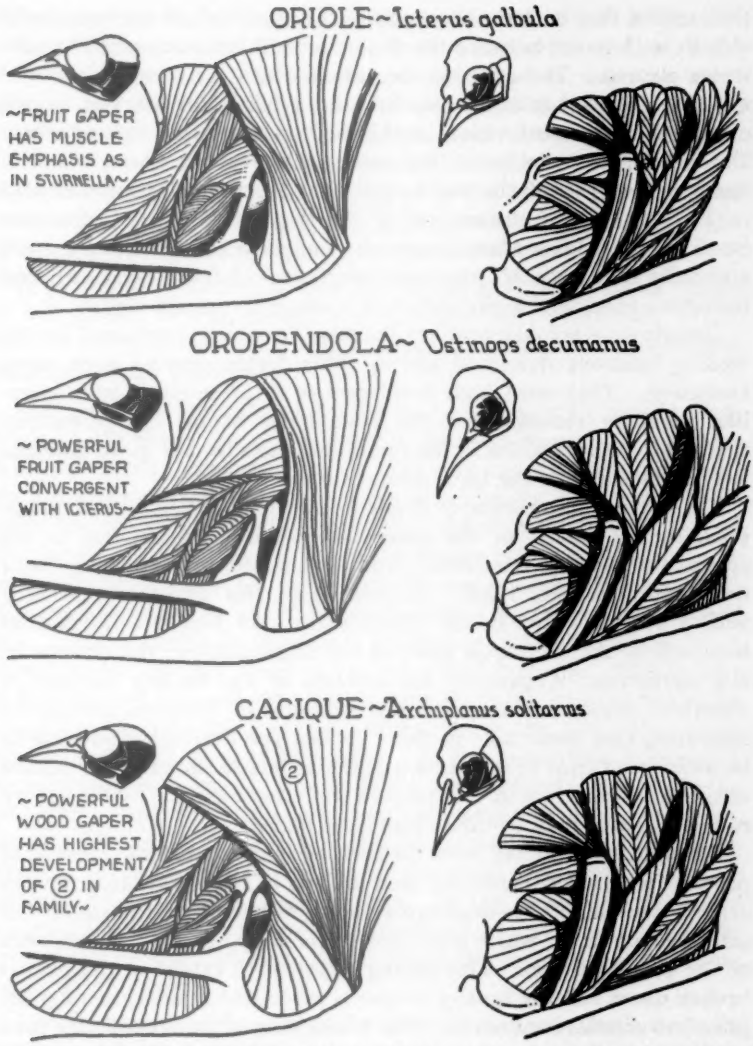
ORIOLE~Icterus galbula
~FRUIT GAPER HAS MUSCLE EMPHASIS AS IN STURNELLA~
OROPENDOLA~ Ostinops decumanus
~ POWERFUL FRUIT GAPER CONVERGENT WITH ICTERUS~
CACIQUE~Archiplanus solitarius
~ POWERFUL WOOD GAPER HAS HIGHEST DEVELOPMENT OF (2) IN FAMILY~
2

FIGURE 6. Detail drawings of basic icterid muscle pattern showing adaptive modifications in various genera.

their orbits, that both the Starling and the Meadowlark are apparently able to see forward between the gaping mandibles to examine the substrate cleared. The eyes can be seen to turn far forward and the zygomae, pinched in at the junction of the bill in the Starling, insure even greater forward vision in this highly specialized insect-seeker. The similar constriction in the secondarily-adapted Meadowlark is less apparent, though the free lacrymal bone in this species (noted also in *Pezites*) may be drawn out of the way in gaping. Unlike the Starling, the Meadowlark retains a good deal of adducting power, especially in a large *M. pseudotemporalis superficialis* (Fig. 5, *6*), and includes a considerable proportion of seeds in its annual diet.

Despite its other connotations the term "gaping" is proposed for the feeding behavior described above, other terms proving even more confusing. This same high development of protractors, with lever-like posterior extension of the mandibular ramus for powerfully spreading the mandibles, is the functional basis for the quite different food adaptations in the three groups following.

The Gaping Adaptation of Orioles.—The gaping adaptation as applied by the orioles of the genera *Icterus* and *Bananivorus* to the special problems of fruit-eating and nectar-feeding has already been described (Beecher, 1950). Anatomically, this adaptation is very similar to that noted in the Meadowlark, and Figure 6 shows that here, again, the protractor muscles are emphasized at the expense of the adductors. Apparently no account of the feeding method of American orioles exists, aside from the notes of Wetmore and others indicating that some take nectar. In fact few ornithologists seem to be aware that fruit in season is a major article of diet, and the failure of this food to appear in the stomach analyses of the Biological Survey suggests that it may be taken mainly as juice.

As might be predicted from the great development of the muscles of protraction and the blade-like modification of the mandibular rami in *Icterus*, the feeding method involves the thrusting of the closed bill into the fruit, after which it is opened forcefully against the resistance of the pulp and skin. This gaping increases in extent as the pulp is broken down and the brushy tongue is protruded rapidly, lapping the juice and shredded material. The broadening of the mandibular rami at the point of greatest wear, their turning inward ventrally, and the sheathing in horn uncommonly far posteriorly form a functional wedge of the lower mandible that is matched by the similar contour of the upper.

In the genus of nectar-feeding orioles for which it has been necessary to revive the name *Bananivorus* (Beecher, 1950) these features are

largely lacking in the lower mandible, except where certain (mainly island) forms have taken over the fruit-eating niche of the absent *Icterus*. However, the increased development of *M. depressor mandibulae* and of the posterior lever of the mandible persists. These relatively slender-billed species still gape, even though only down the throat of a nectar-filled flower. In short-billed species like *Bananivorus cayanensis*, a hole may be pecked in the side of a long-necked corolla and enlarged by gaping. Both genera of orioles also take insects as food, but there are few passerine birds that do not.

A palatal keel essentially like that of the grackle *Quiscalus* occurs in the orioles, *Icterus gularis* and *I. nigrogularis* (Wetmore, 1919). This is thought (Beecher, 1950) to permit use of seeds as food when fruit and nectar are scarce.

The Gaping Adaptation of Oropendolas.—As may be judged from Figure 6 the entire jaw musculature of *Ostinops decumanus* is powerfully developed, correlated with a relatively massive bill, but again the emphasis is placed on the gaping musculature. Figures 7 to 10 place the oropendolas and caciques in a different phyletic branch of this family from the orioles; hence the gaping trait and pendant nest possessed in common by both branches are considered convergent. The prominent casque found in all members of the oropendola-cacique line, which is evidently functional for gaping in large fruits, at once sets them off and they agree well in other skull features. This casque is so blunt and rounded that it seems the blade-like rami of the lower mandible must do most of the cutting inside the fruit, the upper mandible serving more as an anchor. In this connection it becomes considerably less kinetic in the larger oropendolas (10° of arc in *Ostinops*). But the general narrowing and elongation of the mandibles, the extension of the casque onto the forehead dorsally and of the horny covering of the mandibular rami onto the facial area ventrally are all adaptations for gaping of large fruits. In the most highly evolved oropendolas of the genus *Gymnostinops* the facial area, especially around the eyes and all along the length of the lower jaw, has become denuded of feathers.

I have observed the gaping of the Colonial Cacique, *Cacicus cela*, in the zoo. The closed bill was thrust into an orange with a rapid up and down movement of the head, and almost immediately opened and closed very slightly as though in drinking. As the hole deepened the bill was gaped a few times spasmodically and driven in at different angles and gaped again. In the process the bill is often driven in almost to the eyes and the feathers about the bill became sticky with

juice. The tongue may be seen running in and out, although it is difficult to glimpse this.

The Wood-prying Adaptation of Caciques.—In certain caciques we find this same extreme development of protractors, with lever-like posterior extension of the mandibular ramus, put to a functional use that is in part different. Wetmore (1926: 388 ff.) has described the behavior of *Archiplanus* in the field. Unlike orioles which confine their activities to the smaller branches of trees, members of this genus frequent larger branches and dead stumps where they pry in crevices and under bark with the bill partly opened. Dickey and van Rossem (1938: 537) reported *Amblycercus holosericeus*, quite possibly derived from *Archiplanus*, as rapping on branches like a woodpecker. Boucard (1883: 445) described it as alighting on and splitting a weed up its length by a single twist. I assume this is done with the bill fixed in the partly open position, and suggest the term "prying" for this behavior of these two genera. They can still gape but appear to have carried the use of the tool a step farther.

A study of the morphological tree as represented in Figures 7 to 10 indicates that these two are possibly modified from the more generalized caciques, differing by reduction of the casque, and general straightening of the bill. Though anatomically similar to each other, differences in the development of *M. depressor mandibulae* and in the posterior process of the mandible, as well as the operculate nostril in *Amblycercus*, leave relationships in doubt. As indicated in Figure 10, *Amblycercus* could perhaps be derived from *Cacicus* stock as easily as from *Archiplanus*. This would mean that they represent independent, essentially parallel origins of the prying adaptation. But certain features run consistently through the entire cacique line. The general narrowing of the skull noted also in orioles and in members of the so-called Coerebidae (e.g. *Coereba*) appear (Beecher, 1950) to be an adaptation for probing in fruits and flowers. The increase in interorbital distance in the skulls of oropendolas, on the other hand, may merely be a structural adjustment necessitated by the extension of the casque onto the forehead. But all gapers are characterized by some constriction of the base of the upper mandible and of the zygomae at its junction for enhanced forward vision. Though no blackbird compares with the Starling, *Sturnus*, in this respect, a turning forward and downward of the orbit is noticeable even in oropendolas and caciques.

Modifications in the Feeding Mechanism of Other Genera

The remaining genera of the Icteridae fall under one or another of the adaptive categories outlined above. The food niche and the functional modification of the skull and musculature for exploiting it

are in each genus variations of one of those illustrated in Figures 4 to 6. Therefore, it has not been considered necessary to make detailed muscle drawings for all the 38 genera, and they have instead been arranged in the form of a tree in Figures 7 to 10 for convenient comparison of skull, musculature, and horny palate. Although this paper does not concern itself much with phylogeny it is here emphasized

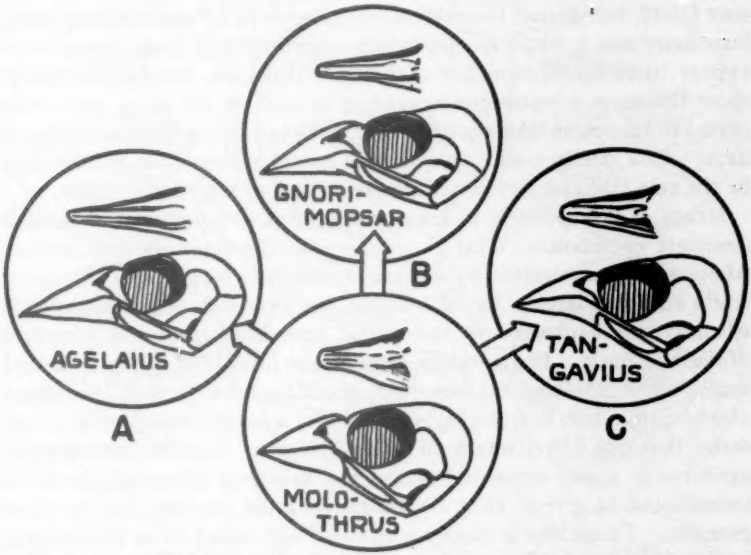

FIGURE 7. Morphological tree showing possible origin of the three major icterid lines from the ancestral cowbird. A. the blackbird-troupial (agelaiine) line; B. the grackle (quiscaline) line; C. the cacique (cassicine) line. The genera figured may closely represent the original divergence and are treated as lying at the base of their individual lines in Figures 8, 9 and 10.

that any such tree, especially when based entirely on genera existing in the present cross-section of time, is really only an expression of morphological relationships. The moment it is taken to imply descent it becomes hypothetical. Therefore, though it simplifies discussion in the following account to say that genus A appears to give rise to genus B, it must be understood that the real truth may be that both stem from an ancestor unrepresented in the present fauna.

All that the figures show is the relative development of muscle masses, skull form, and palate pattern in the genera. An understanding of the adaptations discussed above permits one to predict with some

assurance whether any one of these genera is a gaper, and the field notes of competent observers generally permit us to judge whether the gaping is done in fruit, earth, ground litter, or wood.

Figure 7 indicates three lines which appear to arise from an ancestral stock probably typified by *Molothrus* today. These are: (A) a blackbird-troupial (agelaiine) line; (B) a grackle (quiscaline) line; and (C) a cacique (cassicine) line. The revisions of Sclater (1883–84) and Ridgway (1902) recognized the orioles and meadowlarks as additional lines, but theirs was a static morphological approach and these genera now appear to be unquestionably agelaiine. However, the figures clearly show the same adaptations appearing in each of the lines, and other parallel characters (the pendant nest, for example) appear in all three lines. In a family where convergence even between close genera may be the rule (Beecher, 1950) we can be certain of nothing.

Hence, it is impossible to assign each genus to a particular line with complete confidence. This is not because the lines are not distinct where well characterized by advanced members but, due to the many traits held in common by all icterids, the lines lose their distinctness when traced backward to the initial branching from the ancestral *Molothrus* stock. In the origin of the three lines (Fig. 7) the essential similarity of *Agelaius*, *Gnorimopsar*, and *Tangavius*, both to *Molothrus* and to each other, is apparent; it is only by a careful building up of the series that one can attempt to trace the lines. *Gnorimopsar* appears agelaiine in many respects but has the habits of the grackles and is transitional to genera (Fig. 9) assigned to the grackle line on other grounds. *Tangavius* is clearly a cowbird but seems to be transitional to the giant cowbird *Psomocolax* which appears to be near the direct line leading to the caciques and oropendolas.

The Blackbird-Troupial Line.—In the agelaiine line the old and large genus *Agelaius* (Fig. 8) appears to be the only one with sufficiently wide geographical range to be considered ancestral to all the remaining genera, most of which are little modified from it and appear to come from it or a similar stock independently rather than from each other. The black plumage, which could be so advantageous in *Agelaius* whose vast flocks apparently assemble visually, tends to disappear in solitary descendant forms. The gaping Meadowlarks, *Sturnella*, and the parallel troupials, *Pezites* and *Leistes*—as well as the finch-like Bobolink, *Dolichonyx*, and Dickcissel, *Spiza*—assume protective pattern and color. The most conspicuous forms of the gaping orioles, *Icterus* and *Bananivorus*, which have apparently been selected in large measure for flash-coloration (Beecher, 1950), are protected by the trait of nesting in thorn trees.

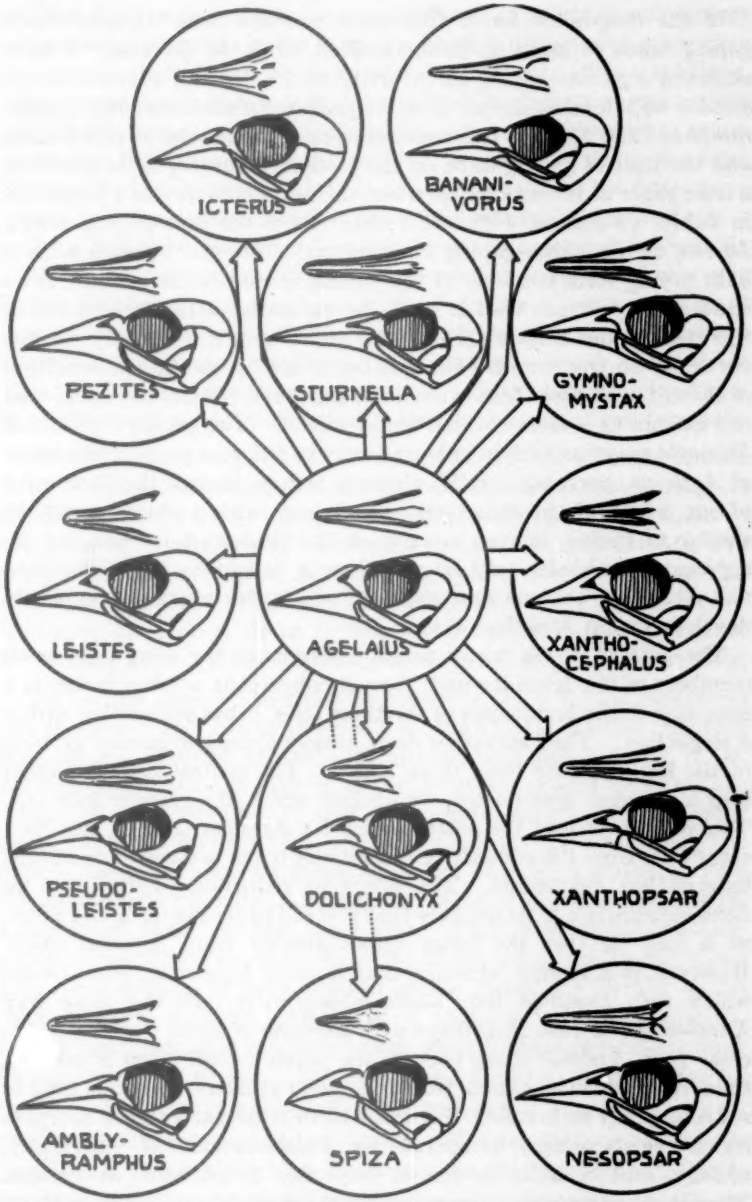

FIGURE 8. Morphological tree showing a possible interpretation of relationships in the blackbird-troupial line.

In the long-billed forms that seem to stem from *Agelaius* stock gaping tends to increase, in short-billed forms, to decrease. I have observed *Agelaius* gaping in captivity and it has *M. depressor mandibulae* well-developed, but *Xanthocephalus*, *Pseudoleistes*, and *Amblyramphus* (Fig. 8) show progressive increase in the area of this muscle and the trait of gaping in or on the ground. *Xanthopsar* is probably a fruit gaper as is *Gymnomystax*, but the latter is more like a blackbird in habits (Wetmore, 1939: 249) than either the fruit-gaping oriole, *Icterus*, or the nectar-gaping *Bananivorus*. *Nesopsar* appears to be a bark-prying form confined to the Jamaican rain forest. There is no anatomical evidence that it could be compared with *Archiplanus* in this respect, but Sclater (1861: 74ff.) stated that it habitually perches vertically on tree trunks (which is borne out by the frayed condition of the tail in all specimens examined), and Bond (1936: 360) mentioned one examining a moss-covered limb for food. The gaping *Pezites* and *Sturnella* may have arisen independently in different parts of the range of *Agelaius*, pursuing parallel plumage trends, though the flash color of one is red, of the other, yellow. *Leistes*, with a plumage pattern similar to *Pezites*, is even more finch-like than *Agelaius* and has *M. depressor mandibulae* only intermediate in development. *Dolichonyx* and *Spiza* are obvious seed-eaters in which this muscle is as poorly developed as in *Molothrus* itself.

The pattern of the horny palate conforms to the same type in all members of the Icteridae and, though convergent overlap makes it a poor clue to the boundaries of the three lines, it has some value within a single line. The two rather deep, closely appressed central grooves of the horny palate form three ridges. The central ridge broadens into a rounded boss posteriorly against which the grooves fade out. This pattern seen in the palate sketch for *Agelaius* (Fig. 8) may be a carry-over from the emberizine finches and tends to persist even in the longer-billed blackbirds. The adaptive reduction of the boss in *Leistes* makes it a little unlikely that it could easily reappear in *Pezites;* so it may be that the latter comes directly from *Agelaius* stock. However, it is readily admitted that it could have come from *Leistes* which then modified the palate subsequently. In the same way *Xanthocephalus* and *Dolichonyx* with similarly reduced bosses seem to come from *Agelaius* stock because the palate modification in deriving them from *Molothrus* stock would be much greater. But this type of reasoning may be invalid. Figures 7 to 10 represent a tree of morphological relationships, tempered by considerations of geography, ecology, and behavior so far as they may be gathered at present. They show one possible arrangement; the facts are quite amenable to other interpretation.

Even if convergent overlap makes it difficult to provide a satisfactory arrangement of genera in the Icteridae, there is little doubt concerning the genera that should be included in the family. The Dickcissel, *Spiza americana*, is here included in the Icteridae largely on the basis of jaw muscle pattern and the horny palate which are in complete agreement with these features in this family. Removal of this genus from the Emberizinae to the Icteridae is not so drastic since the latter have arisen from the former, but it is important as signifying that *Spiza* is really a blackbird and not a borderline case as suggested by Sushkin (1925). Ridgway's (1902) diagnosis revealed no reason for keeping it in the Emberizinae, and absence in the Icteridae of emberizine rictal bristles is not a hard and fast rule. These bristles occur in typical icterids like the caciques; hence their presence, much reduced, in *Spiza* is of little diagnostic importance as compared with the evidence of muscle pattern and palate which may be conservative characters.

The plumage pattern of the Dickcissel is only superficially similar to that of the Meadowlark, but the behavior is similar in many respects to that of the Bobolink. Sushkin and Bangs (Sushkin, 1925) believed the apparent extinction of an eastern species, *Spiza townsendi*, and the gradual disappearance of the present species over the eastern half of its range pointed to *Spiza* as an archaic genus. Since Hellmayr gave no reason for placing *Spiza* in the Richmondeninae, his divergence from the opinion of Ridgway and Sushkin is not to be taken seriously.

The Grackle Line.—The genus *Gnorimopsar* (Figs. 7, 9) is selected as one that could give rise to the grackles or is at least close to the stock that did so. Though generalized, without high development of *M. depressor mandibulae*, it may be on the direct line producing forms like *Notiopsar* and *Dives* (Fig. 9) that are powerful gapers. On the other hand, *Oreopsar*, *Hypopyrrhus*, and *Macroagelaius* are apparently not gapers, the latter showing every indication of close relationship with the reputedly tanager-like *Lampropsar*. From its range in the Central Lowlands of South America, *Gnorimopsar* could have originated these genera in the slowly rising Andes in the latter half of the Tertiary, and here *Dives* appears to have evolved on the direct line leading to the more northern grackles. *Ptiloxena* of Cuba is very similar to it, though less powerful in its musculature, while *Holoquiscalus* is modified for more powerful gaping. The Boat-tailed Grackle, *Cassidix*, despite the curved culmen and long tail, could well stem from the latter with emphasis on both gaping and adducting. The palatal boss seems to be transitional to the highly developed ridge in the Bronzed and Purple grackles, *Quiscalus*, as mentioned earlier. The Brewer's and Rusty

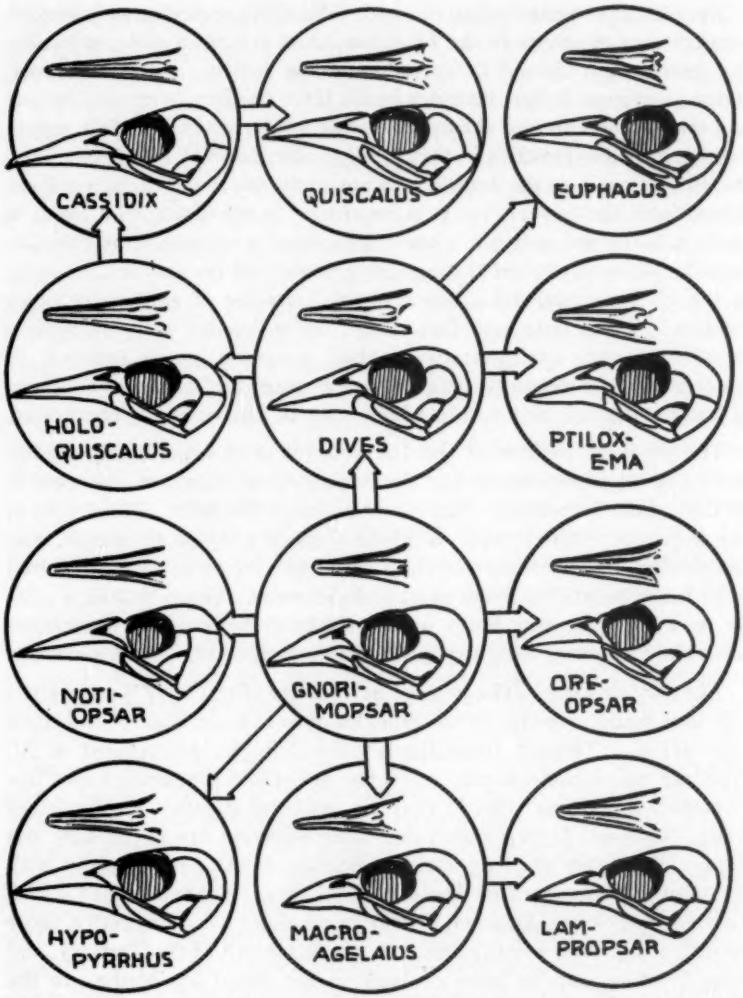

FIGURE 9. Morphological tree showing a possible interpretation of relationships in the grackle line. (For '*Ptiloxema*' read '*Ptiloxena*.')

blackbirds, *Euphagus*, could have evolved from *Dives* stock in Mexico but are hard to place definitely.

The dividing of the palatal boss and its reduction posteriorly appear to reflect a general broadening of the bill posteriorly as an adaptation to insectivorous diet or at least to soft food. *Lampropsar*, reputed to

nest like an oriole and to eat fruit (Cherrie, 1916), has virtually lost the boss posteriorly as has *Gymnostinops* among oropendolas. However, if the former is a fruit-eater it certainly does not appear to be a fruit-gaper, judging by anatomical development.

The Cacique Line.—That *Tangavius* is simply an advanced cowbird with a ruff of elaborated feathers on the back for making more effective the courtship display noted by Friedmann (1929) seems fairly certain. The Rice Grackle, *Psomocolax*, with a similar ruff (Fig. 10) seems to be a giant cowbird with grackle traits, though the flattening of the culmen into the beginning of the casque so typical of the caciques and oropendolas strongly suggests that it may be a transition stage in their evolution. Any other such transition forms have disappeared from the living record, possibly reflecting the positive selective advantage of the casque in those species evolving it over others that failed to do so. Relationship of *Psomocolax* to the caciques and oropendolas is also suggested by the fact that *Psomocolax* parasitizes their nests exclusively, despite the presence of numerous hosts of suitable size within its range, including grackles. There appears to be a definite tendency (Friedmann, 1929) for South American cowbirds to parasitize near-relatives.

The presence of the three monotypic genera, *Ocyalus*, *Zarhynchus*, and *Clypicterus*, in restricted ranges in the Andes suggests the origin of oropendolas in the rising northern Andes. All the genera are already highly specialized, but *Ocyalus* may most nearly represent the ancestral stock of the remaining caciques and oropendolas. At any rate a similar ancestral stock appears to have given rise to the much more numerous oropendolas of the genus *Ostinops* which appears to terminate in the very specialized *Gymnostinops*. All of these are gapers with a notable blade-like broadening of the rami of the mandible and a sheathing of the bill with horn far back into the face. This apparently is associated with the method of probing in fruit, and *Gymnostinops* has also adaptively lost most of the feather covering in the facial area.

This same common ancestor, similar to *Ocyalus*, could have evolved the large cacique branch of this phyletic line. *Cacicus* is the large genus of the abundant Colonial Caciques of which *Cassiculus* of western Mexico is apparently a specialized offshoot. *Cacicus* stock could also easily have evolved the specialized wood-pecking cacique, *Archiplanus*, with the same secondary reduction of the casque noted in *Cassiculus*. The adaptations noted in *Archiplanus* seem to culminate in the still more specialized *Amblycercus*, although separate origin of the two from *Cacicus* is just as valid an interpretation. All these genera in the cacique line (possibly even including *Psomocolax*) are

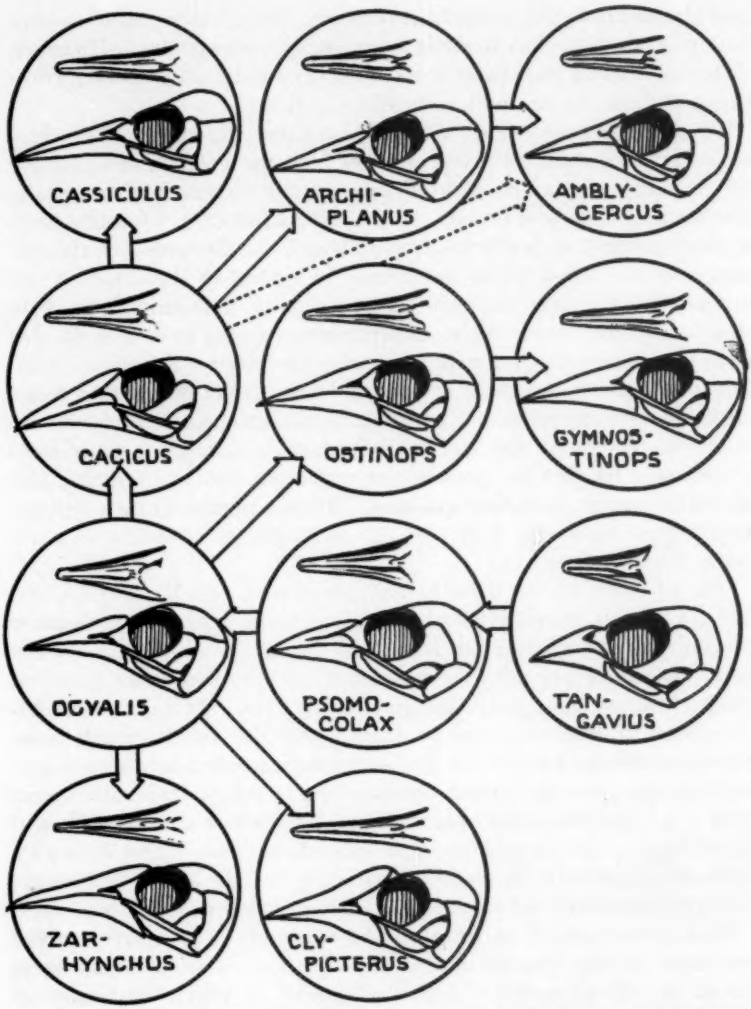

FIGURE 10. Morphological tree showing a possible interpretation of relationships in the cacique line. (For '*Ocyalis*' read '*Ocyalus.*')

gapers, feeding largely on fruit. Although this is not to be gleaned from the literature, Goodfellow (1901: 476) noted fruit depredation on the part of *Zarhynchus wagleri* and Mr. Ernest Holt has assured me that this is a common complaint against oropendolas.

This line may provide a clue to forces governing body size in related bird forms. *Psomocolax* becomes a large cowbird with a casque, and its larger size may be nothing but a response to the abundance of large fruits on which it feeds. Fruit-eating oropendolas of similar or larger size spring from this stock. So do smaller caciques with reduced casques and these appear to evolve wood-prying forms. This suggests an adaptive increase, then decrease, in body size with diet change in the same phyletic line—a phenomenon also noted in the blackbird line. There the fruit-adapted orioles, *Gymnomystax* and *Icterus icterus*, have evolved from *Agelaius* stock with increased body size and bill-length in probable adaptation to the abundance of large pulpy fruits (Beecher, 1950), whereas the nectar-adapted oriole *Bananivorus* has evolved from the same stock with a smaller bill and body. It appears that the body may follow the adaptive lead of the bill regarding size in such food adaptations.

PHYLOGENETIC IMPLICATIONS OF THESE ADAPTATIONS

The "explosive" adaptive radiation of the genera of the Icteridae to occupy, in the present cross-section of time, virtually every food niche available to passerine birds is unique. No other case is known to me of birds of a single family (really subfamily) embracing so many diversified adaptive types. The springboard for this rapid radiation was apparently an adaptation (pre-adaptation) of general significance (Wright, 1941), that is, the ease with which the gaping function and elongation of the bill could be acquired. The posterior, lever-like extension of the mandible and the enormous spread of *M. depressor mandibulae* over the posterior area of the skull permitted the bill to be used in an entirely different manner from that prevalent in the ancestral cowbirds or the emberizine finches of the *Phrygilus* type from which they appear to arise.

At any rate the gaping function has clearly permitted a different use of the bill as a tool in the rapidly evolving Icteridae. Whereas the great host of existing passerine species adapted for insect-eating thrashed about in ground litter, picking up debris and tossing it aside, the insect-eating blackbirds moved debris aside by gaping. Whereas a tanager might bite a piece out of a soft fruit, an oriole or oropendola drove the bill into the fruit closed, then opened it repeatedly inside, lapping the juice. The tongue thus became similar to that of nectar-

feeders like *Coereba*, and there arose an additional oriole line specialized for nectar-feeding. There was also room among the tree-creepers for a wood-pecking group capable of prying or twisting with half-opened bill and the use of gaping by *Archiplanus* and *Amblycercus* to pry under bark probably has no other counterpart in passerine birds. Thus, by developing new uses for old tools, the Icteridae have originated entirely new ways of exploiting food niches.

In the terminology of Wright (1931 and later) and Simpson (1944) the ancestral cowbird might be regarded as arriving on an adaptive peak from which it has been able to exploit other peaks. Wright (*in* Jepsen, Simpson, and Mayr, 1949: 387) expressed the normal process when he observed that "a single peak is replaced by a higher system of peaks"; but, in the sense I understand the peaks, the Icteridae represent a descent to a lower system of adaptive peaks.

This is because the origins of the major food adaptations (the peaks) in passerine birds appear to have occurred in a definite time sequence. Just as the seed-cracking skull is the most complex and recent, the skull of a primary insect-eater in the Vireonidae is the most simple and primitive. It may be permissible to assume that, before the origin of flowering plants in the Upper Cretaceous, all passerine birds were insectivorous, with the simple, parallel muscle pattern still found today in the Muscicapidae, Vireonidae, and the even more primitive Tyranni (Furnariidae, Dendrocolaptidae, etc.). But with the origin of flowering plants we would expect a powerful selection pressure to be imposed on these birds to make use of new food types. Adaptations for utilizing fruit, nectar, and seeds may have appeared in that order—which is in agreement with the order of skull evolution in passerine families of the American assemblage. The sequence from insect- to seed-eater is one of increasing architectural complexity and muscular complexity, with pinnate adductor muscles replacing parallel ones. Returning to Wright's terminology, therefore, I would regard the seed-cracking adaptive peak as highest both in lateness of origin and anatomical specialization. The fruit-eating and nectar-feeding peaks are lower, and the insect-eating peak is lowest of all, anatomically speaking. The secondary radiation of the finch-like blackbirds into fruit, nectar, and insect niches is, in this sense, a movement from a higher to several lower peaks. Apparently a high rate line (Simpson, 1944) like the Icteridae, starting an adaptive radiation from the highest adaptive peak, can rapidly occupy the lower peaks.

The laboring of this point is not merely academic. The fact is that the remarkable radiation of the Icteridae into all the passerine food niches was accomplished by relatively slight changes in skull archi-

tecture and emphasis of certain muscle masses at the expense of the others. There is no change in the basic muscle pattern, such as occurred in each of the less-advanced families that earlier radiated into these niches through perhaps slower evolutionary changes—the vireos, warblers, tanagers, and finches of the American assemblage. The pinnate adductors (of finch origin) persist in the most insectivo-

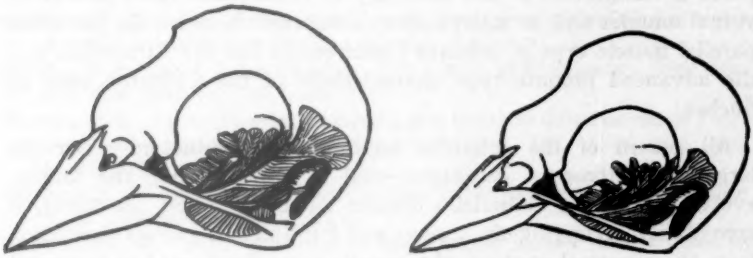

FIGURE 11. Reduction of bill, skull, and bulk of jaw muscle in *Melospiza*. The adaptive reduction of these features with increase in insect diet in the Swamp Sparrow, *M. georgiana*, over the condition in the seed-cracking Song Sparrow, *M. melodia*, does not change the basic muscle pattern.

rous adaptations of blackbirds. The elongation of the pinnate fibers in the Rusty Blackbird, *Euphagus carolinus*, is precisely like that in the largely insectivorous Swamp Sparrow, *Melospiza georgiana*, quite possibly derived (Fig. 11) from the seed-eating Song Sparrow, *M. melodia*.

In future publications it will be shown that this basic muscle pattern is different for each of the passerine families. Each appears to be an adaptive branch on the phylogenetic tree, that has budded off under selection pressure induced by food competition; and bill and skull seem to lead the way in the evolution of these higher categories. Contrasted with this high rate of evolution for the jaw musculature, the hind-limb musculature conforms to a single pattern in Passeres, suggesting a lowered or more stabilized evolutionary rate. But, if the jaw muscle patterns are adaptive they are also phylogenetic. Dissection of several hundred species of passerines shows the jaw muscles to be a reliable additional line of evidence for determining relationship at the family level. It is interesting that the manifold food adaptations of icterid genera have been accomplished within a single muscle pattern, possibly imposed by a genetically deep-seated finch ancestry.

SUMMARY AND CONCLUSIONS

An investigation was made of the feeding modifications in the skull in all genera of the family Icteridae, with special attention to the jaw musculature. The kinetics of the upper mandible and its rôle in the feeding function were studied and the location and functional rôle of the major muscle masses of the skull were outlined briefly. For purposes of comparison it was necessary to break these down into individual muscles and to make a sharp distinction between the primitive parallel muscle type of primary insect eaters like the Vireonidae and the advanced pinnate type characteristic of the adductor mass in finches.

All genera of the Icteridae have pinnate adductors—even the largely insectivorous *Euphagus*—and it appears that the family, evolving from the emberizine finches via the cowbird *Molothrus*, is secondarily occupying the insect- and fruit-niches. In its derivation from the ancestral cowbird, the insectivorous *Euphagus* has elongated the bill, forceps-like, straightened the angulated commissure, and increased the kinetics. The lever-like orbital process of the quadrate, long in finches, is shortened. Its adaptively weak jaw musculature is, however, replaced by powerful musculature in the grackles, *Quiscalus*, which saw acorns and dried kernels of corn by means of a sharp keel of the horny palate and powerful adduction. The Meadowlark, *Sturnella*, uses powerful muscles of protraction, especially *M. depressor mandibulae*, to gape the mandibles in the earth or in ground litter with considerable force. The caciques, *Archiplanus* and *Amblycercus*, are able by means of very high development of this muscle to separate the bark from branches and to pry in cracks. All of the 38 genera fall into one or another of the food-niche categories exploited by the genera discussed in detail, and a rough survey of the adaptations in each of the three phyletic lines—the agelaiine, the quiscaline and the cassicine—is made.

It is suggested that the "key" to the ability of the Icteridae to exploit all passerine food niches from finch-like beginnings has been the ease with which the area of attachment for *M. depressor mandibulae* has apparently increased. The fact that this could occur here and also in other muscular attachments, without modification of the basic jaw muscle pattern, suggests the deep-seated genetic nature of these patterns which are specific to each passerine family. Because of this conservatism in the very seat of adaptation, the muscle patterns may be employed as an additional line of evidence in determining the relationships of the passerine families to each other.

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Chicago Natural History Museum, Chicago, Illinois, May 9, 1950.

LOUIS BENNETT BISHOP, 1865–1950

BY HILDEGARDE HOWARD

LOUIS BENNETT BISHOP, the son of Timothy Huggins and Jane Maria (Bennett) Bishop, was born on June 5, 1865, at the home of his maternal grandparents in Guilford, Connecticut. The Bishops were one of the early families of Connecticut, dating back to John Bishop who settled in Guilford in 1639. The family residence had been in New Haven for two or three generations before Louis was born, and it was there, at 215 Church Street, that Louis grew up.

His earliest schooling was received in a private school maintained by two New Haven ladies. We may picture him, one morning at the tender age of six, trotting through the garden on his way to school, slingshot in pocket, and perhaps a book on a strap. Undoubtedly he is intent on punctuality, for so his parents trained him. But in the garden, close at hand, appears a bird. School is momentarily forgotten, while his trusty slingshot is aimed—oh, so carefully—and the bird falls at his feet. Conflicting emotions bid him—take the bird back to the house, go on to school. Dutifully, he pockets the bird and runs on to school, fearful now of tardiness. We wonder, though, how much he learns this day—the day he collected his first bird. Somehow that bird was preserved and became part of the famous Bishop collection which at the time it was transferred to the Chicago Natural History Museum numbered 53,000 specimens.

Louis was 12 years old, and a pupil in the Hopkins Grammar School in New Haven, before he had any actual training in collecting or preparing bird skins. He and L. C. Sanford were schoolmates and

often walked together in the countryside about New Haven observing birds and shooting them with their slingshots. One day, on returning from a jaunt to nearby Woodbridge, the boys met Willis Wright then a student at Yale. Wright's gun and game bag intrigued the lads, and in the conversation that followed Wright agreed to teach them to collect and mount birds—for a small fee—and to give them the birds used for demonstration. Though Louis quickly learned to skin birds, he found the mounting tedious and decided that his would be a collection of skins. Recognizing the boy's real interest in collecting, the Reverend Bennett, his maternal grandfather, presented him with his first rifle at the age of 14. With the gun went grandfather's promise to the family that he would accompany Louis on all of his hunting expeditions while the boy was growing—for Louis was small for his age. This promise was faithfully kept, though it involved trailing the boy and his companions across fields and through marshes and streams on their many adventures.

In Connecticut society, in which the Bishops occupied a prominent place, a young man was expected to be educated in one of the professions—the ministry, law, or medicine. Both Louis' father and grandfather had been doctors, so it was natural that the son should follow in this line. With this in view, Louis entered Yale, receiving his B.A. degree in 1886. Then, after an unforgettable summer travelling with several other young men of his age down the Nile and camping amid the pyramids, he entered the Yale Medical School. He received his M.D. from Yale in 1888 and carried on additional studies at the New York Polyclinic Medical School, 1888–89, followed by an interneship at the New Haven Hospital in 1889–90. He then set sail for Europe where he spent two years in travel and study at the Medical School of the University of Vienna.

Returning to New Haven in 1892, Dr. Louis Bennett Bishop opened a private medical practice. As it was the custom for a doctor to have his office in connection with his residence, he at this time established a separate residence at 356 Orange Street, around the corner from the parental home. Although he had a housekeeper to keep the place in perfect order at all times, he continued to return to his mother's home for his meals.

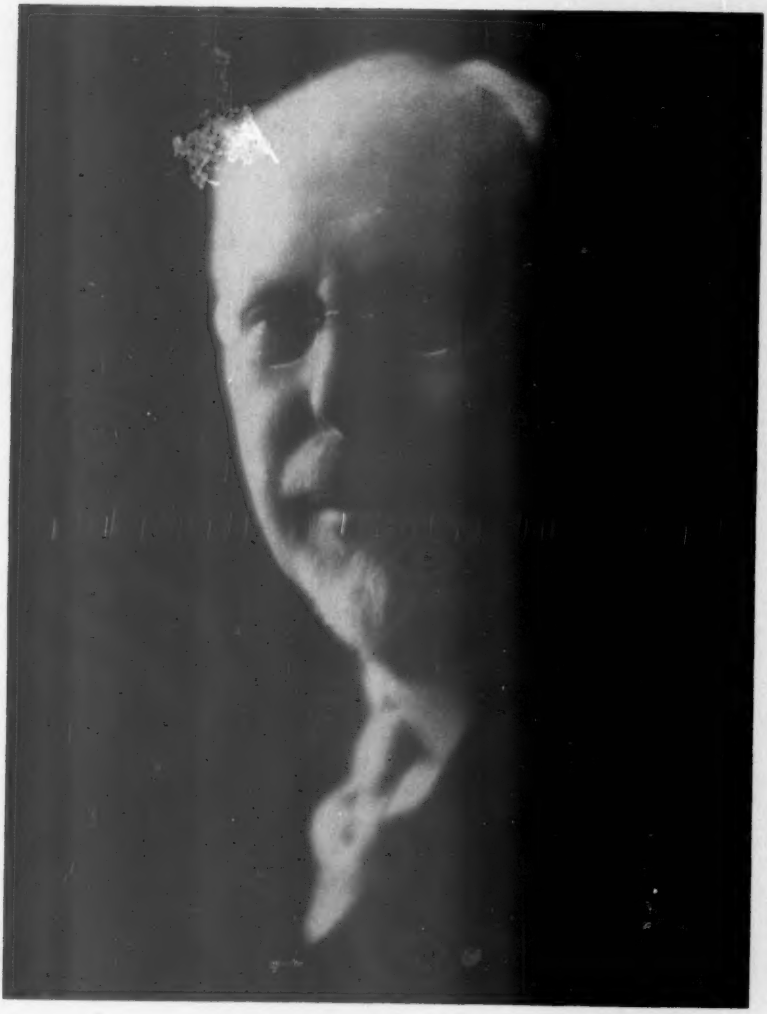
Bishop was a successful doctor, but ornithology was his real interest in life. He spent many vacations in travelling where he could study and collect birds and their eggs. In 1895, 1901, 1902, and 1905 he went to North Dakota; in 1897 to Florida; in 1899 to British Columbia and Alaska, travelling down the Yukon in a small boat; in 1904 to California, British Columbia, and Alberta; in 1906 to Saskatchewan;

in 1908 to the Magdalen Islands; and between 1888 and 1916 many trips were made to Nova Scotia, Massachusetts, New Hampshire, Virginia, and South Carolina.

His first published ornithological note was written when he was 20 and still a student at Yale. At this time (1885) he joined the American Ornithologists' Union as an Associate member. His election to Fellow, in 1901, placed him in the first group to be known as Fellows of the A.O.U. At about this time preparation of the first "Auk index" was begun, and Bishop served on this committee. From 1889 to 1901 his ornithological notes and papers were published almost exclusively in 'The Auk.' The appearance in 1903 of the 600-page volume "The Water-fowl Family" by Sanford, Bishop, and Van Dyke won much favorable comment, particularly Bishop's carefully prepared summaries of habitats and summer and winter ranges. Bishop was a master at observation of details. All his writings reflect his understanding of the importance of accurate recording of such observations. Many notes which he himself did not publish have played an important part in the work of others—as, for example, his excellent color records on gulls, the use of which Jonathan Dwight gratefully acknowledged in his "Gulls of the World."

Bishop met Dwight back in the 1890's. The two were "rival" collectors but became fast friends. It was this friendship which led to the building of a small museum in the garden of Bishop's place on Orange Street in New Haven. Dwight's collection was larger than Bishop's in the 1890's, and he was at a loss to know where and how to house it safely. The spacious garden on Orange Street offered an excellent site on which to erect the proper kind of building for the purpose. Accordingly, Bishop offered the space, and Dwight immediately set about having the building erected. Later, Bishop bought the place from Dwight and this one-story museum, roughly 40 by 30 feet in size, became the depository of a large part of the Bishop collection.

After 15 years of medical practice, which included important posts both in surgery and in pediatrics at the New Haven Dispensary and in the Yale Medical School, Bishop retired from medical work in 1908 to devote his entire time to birds. Two years later, on July 10, 1910, he was married to Leona Anna (Bayles) Sturtevant in New York. The honeymoon was a year spent in travel through Europe and Africa. The occasion of the trip probably accounts for his remark (Auk, 29: 179) "Ornithology was not our aim, and no actual fieldwork was done anywhere. But I kept my eyes and ears open for birds during all parts of our trip . . ." Mrs. Bishop remembers clearly that the gun, which was a part of their luggage, did not go unused. In Italy,



DR. LOUIS BENNETT BISHOP, 1865–1950

however, it was hardly necessary to go hunting for birds as the markets were full of them, thousands of them, hanging in large bunches. Bishop bought quantities of these market birds—larks, starlings, siskins, redbreasts, thrushes, blackbirds, wrens, sparrows—and soon learned that he must quickly direct the salesman to leave the feathers on the birds, as the average purchaser, buying birds for the table, expected them to be plucked at the market. Relieving the salesman of the task of plucking had an effect on the price of the birds, too—it went up; cannily, the salesman knew his wares had a special significance for Dr. Bishop. Perhaps it is unnecessary to add that Dr. and Mrs. Bishop did not share the Italian's love of "skylarks on toast." This delicacy, prepared by the chef at one of the hotels on their journey, was left untouched.

The Bishop's one child, Herbert Bennett, was born to them in 1912 in New Haven. Five years later, the California chapter in Louis Bishop's life began. Coming to California originally for the health of his mother and expecting to spend only the summer, the visit lengthened out to 33 years. A few eastern interludes were necessary to arrange business matters, for Dr. Bishop maintained his New Haven residence for many years.

A great friend of Eugene Law, Bishop chose Hollywood, near the Laws, for winter residence, while the summers were spent at Carmel. Not for eight or nine years was a permanent home established, in Pasadena. The proximity of Hollywood to the hills and canyons, still undisturbed by civilization, delighted Dr. Bishop. Days were spent in tramping the hills, learning the birds of the west, and always collecting. Not too far away, by trolley, lay the beaches. Here, from 1918 to 1920, Bishop and friends from the Cooper Ornithological Club went regularly to study and collect gulls.

The Bishop collection continued to grow. Added to by his own efforts, and also through purchase from collectors abroad and at home, his series of skins housed at the Los Angeles Museum began to rival the collection left behind in New Haven. In later years, when field work was no longer so inviting, Dr. Bishop spent his days at the museum writing and studying his specimens. During this time budding ornithologists were given financial help by collecting and preparing specimens for him. He was very generous and the number of grateful young men whom he assisted is legion. He also generously contributed to many organizations. His memberships numbered more than 30 societies. Most of these were related to natural history in its various aspects, but included also were medical groups, university clubs, and two societies reflecting the background of the

Bishop family in America, namely the Society of the Cincinnati and the Society of Colonial Wars, both of the state of Connecticut.

Dr. Bishop was especially interested in plumage changes and in the slight differences which might, or might not, indicate racial distinction. He collected with these thoughts in mind, collecting from one locality at various times of the year or choosing particular areas which might yield information concerning marginal forms. His became one of the most important study collections in the country, and the loan of his specimens was sought by ornithologists from east to west. Dr. Bishop himself described a number of subspecies, six of which are accepted today—a goodly total in view of the heated arguments which have long existed between the "splitters" and the "lumpers." In view of his several recommendations for new races, Dr. Bishop might be grouped with the "splitters." However, in this group he should certainly be considered a conservative, for no recommendation was ever advanced without considered judgment based on long series of specimens at hand. In fact, we might say that in all things in life Louis Bishop was on the side of the conservatives—indeed militantly so in the realm of politics! Innovations were weighed cautiously before being accepted. Because of this conservatism, the revisions which he sought should be the more convincing. Only by the greatest care in observation of detail would his decisions be made. But once made, he was willing to back them through any amount of criticism. He delighted in discoursive argument, either written or oral, and was not one to mince words in putting over his point.

It was with great foresight that, about ten years ago, Dr. Bishop arranged for the final disposition of his great collection of bird skins and a smaller collection of eggs and nests, as well as a series of sterna of North American shorebirds. The larger collection was purchased by the Chicago Natural History Museum; the smaller was given to the Peabody Museum at Yale. A portion of the skin collection remained in California for his use until, because of failing health, he urged the completion of the transaction, and the last shipment was made to Chicago. His life's work was put in order. His beloved collection in good hands, his note books and catalogues and remaining manuscripts carefully listed, Louis Bishop, who had lived a full, rich life, was ready to meet his Maker. He died April 3, 1950.

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Los Angeles County Museum, Los Angeles, California, January 15, 1951.

STUDIES OF HABITATS, TERRITORY, AND NESTS OF THE EASTERN GOLDFINCH

BY WALTER P. NICKELL

WITHIN the last 17 years (1933–1949), I have recorded 264 nests of the Eastern Goldfinch, *Spinus tristis tristis*, in two counties of Michigan. Three areas are represented: Camps Sherwood and Hilltop on the western shores of Walloon Lake, 10 miles from Petosky in Charlevoix County; Camp Ohiyesa on Fish Lake, near Clyde in northwestern Oakland County; and the Cranbrook area, largely within five miles of the Cranbrook Estate in Bloomfield Hills, southeastern Oakland County. All of the 16 nests found at Camp Ohiyesa were studied during the nesting seasons of 1933, 1934, and 1935. Five nests recorded from Camps Sherwood and Hilltop were examined during the nesting seasons of 1939, 1942, and 1949. Of the 243 nests studied in the Cranbrook area, 183 or more than two-thirds were recorded during concentrated field work through the nesting season of 1949. The remaining 60 nests were found as follows: one in 1942; 43 in 1943; seven in 1944; one in 1947; and eight in 1948. No nests were recorded from 1936–1938, 1940–1941, and 1945–1946 because of duties elsewhere during these nesting seasons.

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HABITATS

The Goldfinch is predominantly a bird of the open country. There is much evidence to indicate that it has extended its habitat over increasingly wider and more varied areas as the forests have been cleared by man's westward moving population. Undoubtedly, it is one of several species of birds which have found greater expanses of open territory quite suitable to their needs. In pre-colonial times, over most of the forested areas of eastern North America, the Goldfinch must have been dependent largely upon open situations created by swamps, lake shores, river banks, and such temporary areas as those laid waste by forest fires. Under such conditions it must have placed its nests near the tops of swamp shrubs or near the ends of horizontal branches at the edge of the forest, much as it does in similar

situations today. Although the largest concentrations of nesting Goldfinches are found in open swamp habitats (as they probably were before the settlement of the country) many nests are found in the shrubs of the adjacent uplands, often several hundreds of yards from swamp situations. As a result of the replacement of dense forests by more open shrub and small tree growth, more extensive areas have become suitable as habitats for the Goldfinch. Moreover, several species of shrubs and small trees which under primitive conditions were confined to swamps and forest edges have spread to these areas and are now being used as nest sites. Other situations made available as habitats for the Goldfinch through the agency of man are fencerows, tree and shrub fringes along roads, and abandoned farm and pasture lands. Old orchards, house sites, and, to some extent, landscaped estates and real estate subdivisions have their nesting populations of Goldfinches. Also, several food plants, not widely available previously, have spread extensively into these open situations; most of those of particular use to the Goldfinch belong to the composite family. Two introduced species which are of great importance in much of the Goldfinch's range in eastern North America are the Canada thistle, *Cirsium arvense*, and the dandelion, *Taraxacum officinale*. Both plants are used as food, while the thistle is also used as a lining material in a majority of the nests.

The Walloon Lake area in which the Goldfinch was found nesting represents a restricted type of habitat which appears to be limited in some of the requirements necessary to attract more than a few nesting pairs. Most of the territory is high, well-drained, and thickly covered with beech-maple, *Fagus grandifolia–Acer saccharum*, forests. The open fields adjacent to these areas are largely lacking in shrub or small tree growth. Most of the fields are used for hay so that only the unmown fringes along the lake shore are available for growing thistles and other composites which appear to be the favorite nesting and food materials of the Goldfinch. All nests found in this area were in trees at woods' edges, an old apple orchard, or at the edge of a recent planting of red and Scotch pine. The height of the nests averaged 18.8 feet above the ground, about three times the average height of nests recorded in southern Michigan. During seven seasons (1938–43 and 1949) of quite consistent search from late June until late August, only five nests of the Goldfinch were found in this area which is about one-fourth of a mile wide and more than two miles long. The scarcity of the Goldfinch in this area as compared with its great abundance in suitable areas in southern Michigan is striking, and probably involves factors of both climate and habitat which have not been shown yet in

studies of this species in the north. This area probably represents a type of habitat which, before it was partially cleared by man, was almost completely unsuitable for the Goldfinch.

The Camp Ohiyesa territory illustrates a group of diversified habitats, only part of which appear to meet the best needs of the Goldfinch. About three-fourths of the mile-square, almost level area is covered with second-growth oak-hickory forests, with thick spruce-tamarack bogs, and with two lakes. Tree growth reaches close to the water's edge around most of the lakes' shorelines so that little room is left for open swamp shrubs in which the Goldfinch nests abundantly in many parts of southern Michigan. The other fourth of the territory is occupied by old pastures, two old apple orchards, and a large leatherleaf, *Chamaedaphne calyculata*, bog encompassing a few scattered black spruce trees, *Picea mariana*. Only limited "edge" portions scattered over the area may be considered suitable habitat for the Goldfinch. Two small sections of open swamp, in which scattered tamaracks, hardhack, buttonbush, and swamp birch were growing, yielded nests. Two other small sections at the edges of oak woods furnished locations for the other nests found. Only 16 nests were found in this area during seven nesting seasons (1930–36) from late June to September. That nesting Goldfinches were not plentiful is indicated here by the fact that I spent two or three hours daily on field trips with nature study groups, a good portion of the time occupied in searching for nests of these and other species. The trees and shrubs in which nests were found in this area were of species different from those used in the Walloon Lake area, and mostly different from species used in the Cranbrook area. The average nest height was 12.2 feet, or about twice the average for the more heavily populated parts of the Cranbrook area. This area, like the Walloon Lake area, appears to be a marginal habitat for the Goldfinch due to a limited number of nest sites and sparsity of food plants of preferred types.

The Cranbrook area exhibits three different types of habitats in which the Goldfinch nests. One of these types (the forest edges and adjacent open fields) is similar to those found in the Walloon Lake and Camp Ohiyesa areas. The nests found in this habitat were usually in tufts of small twigs near the ends of horizontal branches and were much higher than the other sites measured in the Cranbrook area. Twelve nests in this habitat averaged 12.3 feet above the ground.

Another type of habitat found in this area is made up of shrubby fields in dry situations, both hilly and level. These fields are either adjacent to lakes or swamps or up to several hundred yards away from them. Scattered growths of the hawthorns, panicled dogwood,

elms, staghorn sumac, wild plum, wild cherries, ninebark, tartarian honeysuckle, *Lonicera tatarica*, and blackberry briars, *Rubus* spp., compose the predominant woody plants. The herbaceous plants of most use as food and nesting materials of the Goldfinch included burdock, *Arctium Lappa*, bull thistle, *Cirsium pumilum*, Canada thistle, common dandelion, wild lettuces, *Lactuca* spp., common milkweed, *Asclepias syriaca*, and chickory, *Cichorium Intybus*. This type of habitat is one which has developed within about the last 100 years since the land was cleared, farmed, and abandoned. Abandonment permitted the spread of several species of shrubs and trees into open situations. The most important of these are the hawthorns, panicled dogwood, and American and slippery elms. Sixty nests in this habitat averaged 5.2 feet above the ground.

The third and most important habitat of the Goldfinch, as judged by numbers and distributional density of nests, is the open, low situation which may be wet or dry during the nesting season. The predominant types of shrubs found in these territories are panicled dogwood, red osier dogwood, silky dogwood, several species of shrub willows, elder, hardhack, buttonbush, and poison sumac, *Rhus vernix*. Scattered trees at the marsh borders include red maple, slippery elm, quaking aspen, bur oak, and swamp white oak. The herbaceous plants of importance as food and nesting materials include broad-leaved and narrow-leaved cattails, *Typha latifolia* and *angustifolia*, swamp thistle, *Cirsium muticum*, swamp milkweed, *Asclepias incarnata*, and nodding bur marigold, *Bidens cernua*. One hundred and eighteen nests in this habitat averaged five feet above the ground.

TERRITORY

Evidently, one of the prime considerations in the selection of territory is the availability of suitable nesting places. Probably of equal importance is the proximity of food plants such as thistles, wild lettuce, and others. I have never found the nest of a Goldfinch very far from an adequate supply of thistle seed. Several areas of 10 to 40 acres in extent, even after careful search, yielded no nest of the Goldfinch at the height of the nesting season. These areas, both swamps and dry uplands, had been heavily pastured for several years and were entirely lacking in thistle growth. Every other requisite for nesting territory was apparently present. Conversely, I have rarely found an abundance of thistles without finding the nests of one or more pairs of the Goldfinch within a distance determined by the presence of suitable nest sites. In no case was a feeding area found to be more than 200 or 300 yards from the nesting territory and in most instances within

100 yards or less. These findings do not coincide with Margaret Drum's statement (1939: 71–72) that the feeding area may be a mile or more from the nesting site. However, the Goldfinches studied by Drum occupied a more northern and consequently different type of habitat in which both nesting territory and food were somewhat different from habitats in which my studies were made. During every season in which I have studied the Goldfinch, I have noted greater densities of its nests where food and nesting sites were abundant and more isolated territories where both of these requisites were less plentiful or more scattered. Stokes (1950: 114) has observed that "there seems to be a relationship between food supply, nest sites and population density."

Three Goldfinch nests found on August 13, 1949, in the Cranbrook area were grouped within a 50-yard radius in a dry swamp habitat. Two nests each contained five eggs under incubation. One nest held four 2-day young. About 75 yards distant at the swamp edge was a large patch of Canada thistle on which two males were feeding without any apparent conflict. Four nests, all found on August 24, 1949, in the same area, were mapped as forming an acute triangle 45 feet across the base with sides 200 feet long. The distances between three nests were 100 feet along one side of the triangle. Two nests were only 45 feet apart across the base of the triangular area. Three nests contained four, five, and two eggs, respectively, all under incubation. One nest was left unlined and was never used. Four nests were discovered on September 3, 1949, also in the Cranbrook area. Two nests held four 3-day young and five 5-day young, respectively. One nest contained three young, not yet dry, and two unhatched eggs. The young had flown from the other only a short time before, probably on this day, as judged by several soft droppings on the sides of the nest. All these nests were in swamp shrubs within an area about 60 yards across.

Concentrations of nests of the Goldfinch within small areas are undoubtedly less common than those more widely scattered over larger territories. However, my observations lead me to believe that the Goldfinch is a tolerant species in regard to territorial boundaries. My findings agree with those of Walkinshaw (1938: 3) and Nice (1939: 123) that the Goldfinch does not always appear to exhibit strong territorial behavior. However, Drum (1939: 75) and Stokes (1950: 112–113) found that territories were defended vigorously by males and sometimes by females. I believe it likely that abundance or scarcity of food, nesting materials, and nest sites are of greater importance in determining the number and proximity of nests of this

species within a given area than is territorial behavior. I have never observed any intraspecific conflict for either food or nest sites.

THE NESTING SEASON

Although the nesting season of the Goldfinch begins later than that of any other species in Michigan, this species may not always be the last to bring its young from the nest at the season's end. The Cardinal (*Richmondena cardinalis*), Mourning Dove (*Zenaidura macroura carolinensis*), and Cedar Waxwing (*Bombycilla cedrorum*) after interruptions or multiple nestings, sometimes have young in the nest after all Goldfinches are on the wing. The time of nesting of the Goldfinch appears to be correlated with the maturity of certain members of the composite family of plants, especially the thistles, whose seed are used as a plentiful food supply for both adults and young and whose down is often used for lining the nests. Based upon the earliest nests with eggs and the latest nests with young which I have recorded for all three areas represented, the nesting season of the Goldfinch began and ended as follows: Walloon Lake area, July 6 to September 1; Camp Ohiyesa area, July 10 to August 25; Cranbrook area, July 3 to September 25.

TYPES OF NEST SITES

The nest sites of the Goldfinch in this study have been divided into six main types (Table 1). The first and most important type is the upright fork with an average of four, more or less evenly spaced, vertical branches which are used as points of attachment on the sides and forming a cradle-like support for the nest (Plate 13, *left*). The second type is the upright fork also, but differs from the first in having all the branches arranged on one side, leaving the nest unsupported on the opposite side (Plate 14, *top*). The third type is formed of two parallel uprights between which the nest is built with no support underneath (Plate 13, *middle*). The fourth type of nest site is represented by tufts of small twigs growing in an upright position from horizontal branches (Plate 14, *middle*). Nests built in this type of situation rest in cradles of twigs as well as on the main branch and are attached to the upright twigs. The fifth type is represented by nests saddled over and around horizontal branches and fastened to small horizontal twigs or leaves (Plate 14, *bottom*). The sixth type is the rarest nest site I have recorded for the Goldfinch, being represented by only two nests. Nests are wedged between horizontal forks, held in place by overlapping of the nesting materials and by attachment on the two sides (Plate 13, *right*). The bottoms of the nests are

TABLE 1

TYPES OF GOLDFINCH NEST SITES (ALL AREAS)

Type	*Number nests*	*Number points attached*
1 (120 nests)	4	7
	8	6
	17	5
	52	4
	37	3
	2	2
		Average 4
2 (10 nests)	2	5
	4	3
	4	2
		Average 3
3 (3 nests)	3	2
		Average 2
4 (6 nests)	1	5
	2	4
	1	3
	2	2
		Average 3.3
5 (6 nests)	4	2
	2	3
		Average 2.3
6 (2 nests)	2	2
		Average (all types) 3

unsupported, and in this respect resemble the semi-pensile nests of vireos. A search of the literature on the Goldfinch does not reveal any nest found in an artificial site or on the ground. My own records show one nest fastened to an upright wire and resting upon a cross wire in a tangle of bedstraw which had climbed a fence. I have never found a nest on the ground.

PLANTS USED AS NEST SITES

The Goldfinch uses a great variety of trees and shrubs and a few herbaceous plants for its nest sites. The species used vary considerably in different habitats and in different parts of the bird's range. Walkinshaw (1938: 4–5) lists 17 species of trees and shrubs which were used by the Goldfinch in five counties of southwestern Michigan and states that the two dogwoods, "*Cornus amomum* and *stolonifera* are the favorite nesting shrubs in Michigan . . ." These species occupy fifth and third places in my catalogue. Only two species mentioned by him, ash, *Fraxinus* sp., and sassafras, *Sassafras varii-*

folium, are not listed in my total of 36 species for two areas in Oakland County in southeastern Michigan (Tables 2 and 3). It may be noted that Walkinshaw (1938: 7) does not list any of the hawthorns as nest sites, although he mentions materials of this genus used for nesting by the Goldfinch. My studies in the Cranbrook area show that 43 nests were found in hawthorns, second only to the number found in panicled dogwood, the most frequently chosen nest site. Todd (1940: 618) states that "red haws growing in abandoned pastures were frequently chosen." Allen (1930: 52 and 1934: 218) lists "thorn bushes," presumably hawthorns, on two occasions as nest sites for the Goldfinch. Stokes (1950: 117–118) in Wisconsin found 230 nests of the Goldfinch in 14 species of trees, shrubs, and forbs. Some pronounced differences are found in the relative abundance of several species of shrubs and in the relative number of nests found in both shrubs and forbs in his study area and mine. Sixty-eight per cent of his nests compared to 3.4 per cent of mine were in elderberry. Eight per cent of Stokes's nests were in "dogwood"; 38 per cent of mine were in three species of dogwood. Stokes lists "hawthorn" as sites for "small numbers" of nests outside his study area. Over 17 per cent of my nests were in hawthorns. In order of abundance in his swamp habitat, Stokes puts elderberry, red osier dogwood, buttonbush, and tartarian honeysuckle. My list for swamp habitats includes, in order of abundance, panicled dogwood, red-osier dogwood, silky dogwood, willows, elderberry, hardhack, and buttonbush. Tree birches, not included in my list, are reported as nest sites in Quebec by Mousley (1932: 200) and in Maine by Gross (1938: 253).

Herbaceous plants are apparently among the rarest nest sites used by the Goldfinch in many parts of its range. This is not surprising, as only a few species of plants are sufficiently strong or branching to furnish safe anchorage for nests. Exceptions are some of the thistles, corn, sunflowers, asters (*Eupatorium*), wild lettuce, and the goldenrods. My list includes three nests in two species, bedstraw and goldenrod. Two nests in Iowa have been reported in bull thistle by Pierce (1922: 186) and Lynds Jones (1922: 186). Ten nests were found in Canada thistle in Ohio by Nice (1939: 123). Roberts (1932: 369) lists a nest in "thistle," apparently swamp thistle, and shows a photograph of the nest from Minnesota. Dugmore (1904: 144) mentions large thistles and coarse ferns as occasional nest sites. Stokes (1950: 117) lists 11 nests or five per cent of his total in thistle and states (1950: 125) that Lewis (unpublished) found the remarkable number of 608 nests in thistle during a four-year period at St. Paul, Minnesota. Stokes also lists sunflower, *Helianthus giganteus*, joe-pye weed, *Eupatorium*

TABLE 2

SITES OF 243 NESTS OF GOLDFINCHES IN THE CRANBROOK AREA, MICHIGAN, BY SPECIES OF TREES AND SHRUBS

Plant species	*Number nests*
Panicled dogwood, *Cornus racemosa*	63
Hawthorns, *Crataegus* spp.	43
Red Osier dogwood, *Cornus stolonifera*	25
American and slippery elms, *Ulmus americana* and *fulva*	22
Silky cornel, *Cornus obliqua*	12
Shrub willows, *Salix* spp.	12
Common elder, *Sambucus canadensis*	9
Red maple, *Acer rubrum*	6
Privet, *Ligustrum vulgare*	6
American aspen, *Populus tremuloides*	6
Osage orange, *Maclura pomifera*	5
Apples, *Malus* spp.	3
Bur oak, *Quercus macrocarpa*	3
Staghorn sumach, *Rhus typhina*	2
Hardhack, *Spirea tomentosa*	2
Choke cherry, *Prunus virginiana*	2
Common locust, *Robinia Pseudo-Acacia*	2
Wild plum, *Prunus americana*	2
Wild black cherry, *Prunus serotina*	2
Prickly ash, *Zanthoxylum americanum*	2
Shrubby bittersweet, *Celastrus scandens*	2
Goldenrods, *Solidago* spp.	2
Swamp white oak, *Quercus bicolor*	1
Ninebark, *Physocarpus opulifolius*	1
Box elder, *Acer Negundo*	1
Red mulberry, *Morus rubra*	1
Common buttonbush, *Cephalanthus occidentalis*	1
Nannyberry, *Viburnum Lentago*	1
Lilac, *Syringa* sp.	1
Grapes, *Vitis* spp.	1
Silver poplar, *Populus alba*	1
Bedstraw, *Galium* sp., on wire fence	1
TOTAL SPECIES	
Shrubs	16
Trees	13
Vines	2
Herbaceous Plants	2

maculatum, asters spp., wild lettuce, *Lactuca* sp., and goldenrod as sites for 21 nests or nine per cent of his total. Barrows (1912: 477) mentions a nest found in a corn shock by Samuel Spicer of Genessee County, Michigan. Parks Allen of Ithaca, Gratiot County, Michigan, told me of a Goldfinch nest which he found on an ear of standing corn in his field about 1940.

Apparently, the Goldfinch in its chosen territory will use almost any species of tree, shrub, or herbaceous plant which provides the requirements of safe anchorage along the sides of the nest, proper support underneath, "normally" safe height above the ground, concealment, and either vertical or horizontal "edge." Nests found in sites which

do not meet most of these requirements are, in my experience, exceptions. Apparently, certain structural factors found in the trees, shrubs, or herbaceous plants are important in the determination of sites. The minimal number of points of attachment appear to be two, as I have never found a nest with less than this number. Table

TABLE 3

SITES OF 16 GOLDFINCH NESTS AT CAMP OHIYESA, MICHIGAN

Plant species	*Number nests*
Tamarack, *Larix laricina*	4
Red oak, *Quercus rubra*	4
Hardhack	2
Swamp birch, *Betula pumila*	2
Red maple	1
Elm	1
Swamp white oak	1
Common buttonbush	1
TOTAL SPECIES	
Shrubs	3
Trees	5

1 shows the number of points of attachment counted for all types of sites. It will be noted that upright forks, with three or more forks (points of attachment), were used for 124 of the 147 nests (or 84.4 per cent) of those whose forks were counted. An analysis of Table 2 shows that the first eight species of trees and shrubs account for 186 nests (or 76.5 per cent) of the total. Apparently three factors largely account for this high percentage of nests found in a few species. The first is found in the relative abundance of these species present in the habitat. The second and third factors are revealed in the mechanical structure and growth habits of the species concerned—that is, a structure and distribution which furnishes the most satisfactory type of nest site for the Goldfinch. Panicled dogwood, in which nearly 26 per cent of all nests in the Cranbrook area were built, is the most abundant shrub listed for both swamps and the dry bordering territory. Its branching, upright growth furnishes a cup-like resting place for the nest, with a maximum number of branches for points of attachment. Moreover, its habit of growing in clumps provides nearly a maximum amount of "edge" which appears to be one of the primary nesting requirements of the Goldfinch. The hawthorn group, although almost entirely restricted to open dry slopes and fields and less widely distributed, meets all the other requirements. This genus furnished sites for 17.7 per cent of all nests tabulated for the Cranbrook area. Although the other six species were neither as abundant in the study area nor as suitable structurally as panicled dogwood and the hawthorn

group, their distribution in relation to "edge" was similar. Nearly 33 per cent of the nests for the area were located in these species. Of the 25 other species, 13, which included privet, osage orange, apple, black locust, wild plum, prickly ash, ninebark, box-elder, red mulberry, buttonbush, nannyberry, lilac, and silver poplar, were scarce or restricted in the study area and accounted for only 11.1 per cent of all nests. The remaining 12 species appeared to fall into various categories; red maple, bur oak, swamp white oak, and black cherry are

TABLE 4

SITES OF FIVE GOLDFINCH NESTS AT WALLOON LAKE, MICHIGAN

Species of trees	*Number nests*
Red pine, *Pinus resinosa*	1
Scotch pine, *Pinus sylvestris*	1
Apple	1
Sugar maple, *Acer saccharum*	2
TOTAL SPECIES OF TREES	4

mostly restricted to the margins of woods, where they appear to be used as nest sites largely because of the scarcity or absence of other suitable species. Choke cherry and staghorn sumac are neither abundant in the habitat nor ordinarily structurally suitable. Hardhack and quaking aspen are relatively plentiful in the nesting areas but are poor structurally. Bittersweet, grape, and bedstraw were used only when climbing upon more rigid species to which nests were partially attached. Goldenrods were abundant in many of the nesting areas, but only a few large plants growing in rich soil were strong enough to support a nest. One of the two nests found in this plant blew down during a strong wind and the young were destroyed. Stokes (1950: 124–125) reports that "nests built in elderberry heavy with fruit or in forbs were subject to destruction by high winds and were found tilted so far over that eggs or young had fallen out."

HEIGHTS OF NESTS FROM GROUND

The heights of nests above the ground vary greatly in different types of habitats and especially in situations where both shrubs and larger trees are found. The higher nests are in trees along fencerows and woods' edges. Four nests in red oak averaged 22.8 feet above the ground. The highest nest was 33 feet up in red oak, the lowest nest one foot above the ground in hawthorn. Two nests in sugar maple averaged 25 feet. Homer Roberts (MS) reports a nest at the University of Michigan Biological Station in Cheboygan County, Michigan, at a height of 45 feet in sugar maple. Three nests in tamarack

averaged 14.7 feet; five nests in red maple averaged 13.2 feet; 22 nests in high shrubs such as hawthorn, privet, and willow averaged 7.6 feet above the ground. The average height from the ground to the rims of 211 nests was 6.1 feet. Stokes (1950: 118) measured 278 nests which averaged about five feet above the ground. Walkinshaw (1938: 5) found 111 nests averaging about 4.3 feet from ground to rim.

THE NEST

So durably built and strongly secured are most nests that they often remain in position for several years unless they are dismantled for nesting material by other birds or by small mammals. The lining is usually thick and so compact that an unoccupied nest will sometimes hold water for several hours after a heavy rain. Allen (1934: 218) states that nests are cushioned so tightly that they will hold water and even drown unprotected young. Forbush (1929: 28) and Walkinshaw (1938: 5) also mention that these nests hold water. Several times I have observed water standing in nests but have never found young birds drowned in them. At Cranbrook on July 9, 1944, I found a newly lined nest containing a half-inch of water several hours after a heavy rain. Usually the leaf canopy of the tree or shrub in which the nest is built gives adequate protection from all except severe cloudbursts. However, late nesting birds which use hawthorns or the dogwoods sometimes find themselves without cover when the leaves of these species drop in the early fall. Nests are easily found under these circumstances, as they may be seen at some distance. The leaves had dropped from many of these shrubs by September 10, 1949, in the Cranbrook area. Five active nests were found in leafless shrubs. One was in hawthorn, one in osier dogwood, and three in panicled dogwood. One nest held five young, three contained four young each, and the last held three young. The young flew from the first four nests in the following order: September 20, 20, 22, and 24. The young were abandoned in the last nest on September 25 and were dead the next day. When the three young flew from a site in common locust on September 22, the nest was still well-hidden by green leaves.

Materials of the Nest.—The plant materials used are many and varied despite the high percentage of nests in which thistle down is used as a lining material and the outer stem fibers of milkweeds for fastening and binding the outer basket. Many odds and ends of various kinds are used as fillers when the basketwork is being shaped, bound together, and fastened to the surrounding twigs and leaves. I have often seen the female pulling in all the loose and projecting

materials within reach and fastening them to the sides of the nest. Nesting materials are usually gathered in the vicinity of the nest site. Any apparent specificity in nesting materials, such as milkweed fibers and thistle down, is probably explained by their presence in adequate amounts in the habitat. Other materials which meet the basic requirements of flexibility and strength for bindings, and of softness and ease of compaction, are often used when they are as easily obtained.

The Basket of the Nest.—The initial steps in nest construction may vary somewhat, apparently in accordance with the limitations imposed by the structural features of the nest site itself and the "impulses" of the individual builder. One of two major procedures is usually followed. If the first two or three inches at the bottom of the fork is too narrow to permit a framework of normal diameter, the first step of the builder may be to fill this with bulky material. This may be thistle down, dry willow catkins, cattail down, or other material. Then, the normal-sized basketwork of fibrous materials is woven and fastened to the surrounding branches immediately above. Sometimes narrow forks are not filled at the bottom, and thus the nest is unsupported except at the sides. Again, a small cross twig may be the nest's only support on the under side. The second procedure is followed when the bottom of the fork conforms to, or does not interfere with, the normal size limitations of the nest. In this case, the outer framework is constructed without the necessity of any adaptation of materials to site, other than those required in the usual process of nest construction. Not infrequently nests are found which show that no outer basket was constructed, the bulky materials being held together by the enclosing branches of the fork. Nests of this type are probably the result of an abundance of thistle down or cattail fluff near at hand and perhaps the "physiological urge" for speed in the preparation of the nest for the eggs. Of a total of 124 nests dissected, 80 (64.5 per cent) contained milkweed fibers in the basket and binding; 21 (nearly 17 per cent) contained the husks of dried willow catkins; seven contained cattail fluff; three had considerable amounts of fine grasses; one had milkweed down; one had down of thimble-weed, *Anemone virginiana;* and 11 nests had outer portions made of thistle down, largely unbound by fibrous materials. Other materials used less commonly or in smaller amounts are spider webs and cocoons and the dried froth of spittle-bugs, family *Cercopidae*, which is sticky and somewhat silklike. The webs of the tent caterpillar, *Malacosoma americana*, also were used. I have never found moss in nests, although a few authors list this material. Roberts (1932: 370), Headstrom (1949: 84), Dugmore (1904: 144), and Stoner (1932: 707) mention "moss" as a part of the basketwork of nests.

The nest is often rimmed with strips of the thin outer bark of grape, hawthorn, ninebark, and other shrubs, and the outer fibrous portions of some herbaceous plants. Some nests are rimmed with the down of thistles, thimbleweed, milkweed, cottonwood, willows, and the bright red-brown tomenta of ferns. These materials are held in place by fine fibers, spider silk, and caterpillar webs, apparently aided by some moistening secretion of the bird. The strength of the rim may be of some advantage in holding the young together for warmth and other protection from the elements. Most nests in upright forks go through the nesting season with only a slight flattening of the rim. Some indication of the degree of flattening is shown in the difference of 0.17 of an inch in average inside depths I measured in fresh and used nests. The flattening is considerably greater in horizontal sites because nests often lack support at the sides. The rims and sides of nests in which three or more young have been raised are almost invariably encrusted with dried excrement which often extends to the vegetation below. However, I have never found the inside of a nest fouled or any evidence that insects are attracted by the filth on the outside. I have one record of mite infestation in the nest of a Goldfinch. This was at Camp Sherwood, August 23, 1939. In contrast, my records of Eastern Kingbirds, *Tyrannus tyrannus*, Least Flycatchers, *Empidonax minimus*, Phoebes, *Sayornis phoebe*, Catbirds, *Dumetella carolinensis*, Robins, *Turdus migratorius*, Red-eyed Vireos, *Vireo olivaceus*, and Redstarts, *Setophaga ruticilla*, show many mite-infested nests.

The Lining of the Nest.—The usual lining of the nest is composed of both soft and warm materials compactly filling the outer basket and thinning upward to the rim. Within the cup of the lining is a thin supporting layer of hair-like fibers which tend to hold the linings in shape during the incubation period or longer. Much of the material of this layer is the finely shredded bark of grapes, hawthorn, and other shrubs. More rarely, rootlets and the coarser hair of horses and cattle are used. Three of 124 nests dissected contained horsehair and one contained rootlets. Soft materials composing the bulk of the linings in these nests were as follows: thistle down, 96 nests; thistle and cattail down, six; cattail down alone, 19; cottonwood fluff, one. Two nests were used without linings. It will be noted that 22 (17.7 per cent) of these nests contained no noticeable amounts of thistle down in the linings. Nearly all students of the Goldfinch list thistle down as the predominant lining material of the nest. A few writers list cottony material, and I have found two authors, Mousley (1930: 177) and Stokes (1950: 117), who specifically mention cattail down in a nest

lining. Nests studied by me show 15 per cent lined with this material and 4.8 per cent lined with mixtures of thistle and cattail down. Jones (1940: 92–93) gives an account of a nest in Virginia which was lined with the spines of the prickly pear cactus. Gross (1938: 253) describes a nest which was composed of vegetable fibers and catkins. Thistle down was not used. Most nests after being used by young show severe wear in the upper part of the lining.

Measurements of the Nest.—Measurements of 46 completed but unused nests in upright forks averaged: 2.0 inches inside diameter; 2.9 inches outside diameter; 1.6 inches inside depth; and 2.8 inches total depth. Twelve (26 per cent) of these nests were deeper than wide, and four (8.3 per cent) were the same dimensions in diameter and depth. The least and greatest measurements ranged from: 1.5 inches to 2.5 inches inside diameter; 2.5 inches to 3.5 inches outside diameter; 1.3 inches to 2.3 inches inside depth; and 2.1 inches to 3.5 inches outside depth.

Three unused nests in horizontal sites averaged: 1.9 inches inside diameter; 3.0 inches outside diameter; 1.5 inches inside depth; and 2.2 inches total depth. All three nests were wider than deep.

Seventy-nine used nests in upright forks averaged: 2.3 inches inside diameter; 2.9 inches outside diameter; 1.5 inches inside depth; and 2.8 inches total depth. Thirty (38.0 per cent) were deeper than wide, and 14 (17.7 per cent) were of equal diameter and depth. The least and greatest measurements ranged from: 1.9 inches to 2.6 inches inside diameter; 2.3 inches to 3.3 inches outside diameter; 0.50 of an inch to 2.0 inches inside depth; and 1.8 inches to 7.0 inches outside depth.

Five used nests in horizontal positions averaged: 2.6 inches inside diameter; 3.0 inches outer diameter; 1.3 inches inside depth; and 2.4 inches outer depth. All nests were greater in width than in depth. My measurements of nests in vertical forks agree with Walkinshaw (1938: 8) that "some nests were much deeper than wide but the majority were wider than deep." My studies show that all nests, either fresh or used, in horizontal positions were wider than deep, but 33.6 per cent of all nests in vertical forks were deeper than wide. Also, 14.4 per cent were the same dimensions in width and depth. These findings do not agree with those of Allen (1930: 52) that nests of the Goldfinch are always wider than high. He makes essentially the same statement in two other publications (1928: 291 and 1934: 221). However, he indicates (1930: 52 and 1934: 218) that Goldfinches in his study area showed a preference for maples. This may indicate that most of the nests he measured were in horizontal sites in

larger trees. The majority of nests I have found in large trees were in horizontal sites near the ends of branches. All nests I found in horizontal sites were wider than high. I believe that the outer dimensions of the nest are often determined by the type of site and its dimensions, as well as by the abundance or scarcity of suitable materials in the nesting area. The female, when building in an upright fork, tends to adapt the nesting materials to the width of this site, as a result of securing the nest at the sides, and often to the degree of its spread from a narrow base. Considering the variation in fork widths, it is not surprising that nests which conform to the inner dimensions of these forks vary in a like manner. When building on horizontal sites, the builder has more freedom and is not usually confronted with the necessity of adapting to the limits of fork dimensions. Moreover, a great abundance of suitable building material near the site appears to

TABLE 5

DRY WEIGHTS IN GRAMS OF 10 FRESH GOLDFINCH NESTS

Basket	*Lining*	*Total*
5.6	2.7	8.3
8.7	3.6	12.3
8.8	1.2	10.0
7.7	4.2	11.9
7.7	2.4	10.1
4.0	2.0	6.0
7.3	1.2	8.5
4.9	1.0	5.9
3.6	1.5	5.1
4.0	3.5	7.5
AVERAGE *6.2*	*2.3*	*8.6*

stimulate in some birds the use of greater than normal amounts, resulting in nests of larger outside dimensions. The inner dimensions of the nest appear to be more definitely determined by the final molding actions of the builder. The average difference between the inner diameters of fresh nests in vertical and horizontal sites was only 0.05 of an inch in 49 nests measured. The average difference in inside depth was 0.14 of an inch, being greater for nests in vertical forks.

Weights of Nests.—Weights of nests show considerable variation due to size, kinds of materials, and degree of compaction. Thus, a smaller nest built more compactly of heavier materials may equal or exceed in weight a nest of larger dimensions. Nests containing catkins, leaves, grass, and larger amounts of bark fibers of trees are usually heavier in proportion to size. Also, nests lined with cattail down are heavier in proportion to the amount used than those lined with thistle down. Twenty dry nests were weighed after removal from their

forks. These were divided equally into fresh nests and those used by young birds. Linings were carefully removed and weighed separately. The used nests averaged heavier than those in a fresh condition owing to the accumulation of feather scales, feces, and other debris. The two heaviest nests weighed 13.6 grams each; one contained hawthorn leaves in the basket and had a lining of thistle down and the other had a thick lining of cattail down.

TABLE 6

DRY WEIGHTS IN GRAMS OF 10 GOLDFINCH NESTS USED BY YOUNG

Basket	*Lining*	*Total*
5.6	3.5	9.1
10.8	2.8	13.6
6.4	2.4	8.8
7.4	2.7	10.1
9.5	4.1	13.6
7.1	3.3	10.4
6.9	2.1	9.0
8.1	2.7	10.8
6.6	3.2	9.8
6.8	3.3	10.1
AVERAGE *7.5*	*3.1*	*10.5*

RECLAIMED NESTING MATERIALS

Drum (1939: 74) mentions the use of reclaimed nest materials by the Goldfinch. I mentioned this behavior (1943: 52–53) in citing two observations in 1933 during which I saw Goldfinches dismantling the nest of a Baltimore Oriole, *Icterus galbula*, and a Yellow Warbler, *Dendroica petechia*, and using the milkweed fibers in the basketwork of their own nests. Stokes (1950: 119) states that "following nest failure females commonly used material from the old nest or even material from a neighboring active nest." I have found indirect evidence of this type of behavior common in every study area. Two nests found September 1, 1943, in the Cranbrook area were three feet apart in the same elm. The first nest had been finished and partially dismantled. The second nest was under construction. Ten days later I found the first nest in the same condition as before and the second nest had been partially dismantled. Three nests found September 2, 1943, were 15 feet apart in a large clump of willows: one nest had been completed and partially dismantled; one was being lined; and one consisted of an unlined basketwork. Four nests were found in an area of less than an acre on August 19, 1949: two nests were finished and not used; the young had flown from one; and one had been partially dismantled. Five other nests of the Goldfinch showed

partial dismantling in the Cranbrook area in 1949. For a number of years I have observed that few nests of Yellow Warblers and Alder Flycatchers, *Empidonax traillii* (which I had marked with heavy tags), remained in place through the nesting season of the Goldfinch. I believe that the Goldfinch is largely responsible for their disappearance. Apparently in gathering nesting materials from the nests of other birds the Goldfinch seeks largely those which are suitable for use in the basket of its own nest. Of these, the flexible outer fibers of the milkweeds and other plants are in the majority. In dismantling its own nest, it may use both basket materials and lining. Vertical cross-sections of the older nests are often left behind. Occasionally only the basket materials are removed, leaving the lining unattached in the site. This type of behavior in the Ruby-throated Hummingbird, *Archilochus colubris*, has been reported by Todd (1940: 311), in the Blue-gray Gnatcatcher, *Polioptila caerulea*, by Herrick (1935: 143), and in the Yellow Warbler by me (1943: 53).

UNFINISHED NESTS

The problem of nests which are left unfinished is one which will require much further study before an adequate explanation is reached. Most of these nests are found near one or more other nests which have been completed and used. Sometimes a third nest will have been finished and abandoned. Margaret Drum (1939: 74) describes two pairs which abandoned their original sites after carrying nesting material. My studies in 1943 showed six nests left in various stages from bare beginnings to the unlined basketwork. Ten examples of unfinished nests were recorded in 1949. Most nests left unfinished were found in the early part of the nesting season, remaining unfinished throughout. However, some new but unfinished nests were found near active ones well into September. On August 28, 1949, I watched a female Goldfinch as she wrapped fibers around the forks of a small nannyberry which was about 100 yards from an occupied nest. No further material had been added when I finally collected the nest on September 20. I believe that these incomplete nests are the work of the female, as I have never observed a male Goldfinch giving more than token assistance in nest-building. Herrick (1935: 133) mentions this type of behavior in the Red-wing and notes that Howard (1929: 48) in England found "Buntings" and "Warblers" building two or three nest frames but completing only one nest. Herrick suggests that it may be a "later manifestation of that phase of conduct in which a bird seems to be merely playing with her nesting materials before the normal rhythm of nest-building has become established."

Armstrong (1947: 37) says "when a bird is not physiologically mature for the activities of a particular phase in its cycle the execution of the reactions appropriate to that phase will be incomplete or abortive. It is often in such circumstances that birds fidget aimlessly with material or build imperfect nests." Walkinshaw (1938: 6) describes a nest of the Goldfinch which was started, apparently abandoned, and finally completed after 20 days, either by the original female or by another. All incomplete nests I have observed either have been finished within a week or have been abandoned.

While physiological considerations as outlined by Armstrong may be a partial explanation of incomplete nests of a species such as the Goldfinch, I believe that several external factors may operate to some extent. Adverse weather conditions may cause delay which results in abandonment. A sudden fright from enemies may cause nests to be abandoned. I have observed that frames are often found in forks which are narrower than the average in which the completed nests are built. I believe that some birds begin nests in such forks and at some stage in the construction of the basket find them too confining for "comfort" and abandon them. A frame of this type was found in the Cranbrook area on August 28, 1949. The inside measurement of this fork was a scant two inches at the level of the rim or more than three quarters of an inch narrower than the average for all nests measured in upright forks. An adaptation mentioned under "The Basket of the Nest" is the filling of the narrow portion with bulky material until adequate fork-width is attained. This adaptation is not always followed. Twigs, stubs, and thorns (hawthorns) sometimes penetrate the sides or bottoms of nest frames in such a fashion as to constitute possible obstacles to further building. Some so-called double nests of the Goldfinch appear to be the result of by-passing such obstacles and covering them with more materials instead of abandoning the site. The strength of the female's attachment to the site and the urge toward egg-laying may be determining factors in the reactions of individual birds.

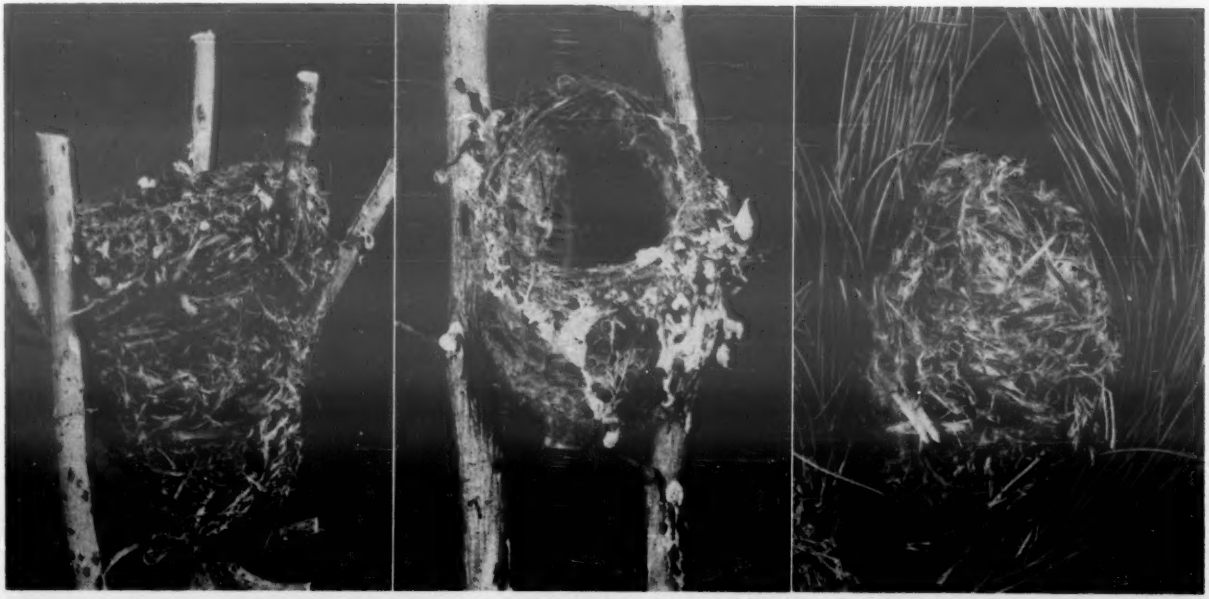
ABANDONMENT OF COMPLETED NESTS

I have recorded several completed nests which have been abandoned before an egg was laid. During August, 1943, a survey of about ten acres in the Cranbrook area revealed 17 nests of the Goldfinch. Four nests had held young, one contained young about a week old, and one contained two fresh eggs. Eleven nests were complete but showed no evidence of having contained eggs. Four other completed nests were abandoned in a territory near by. In 1949, 20 nests at Cranbrook

were completed and abandoned without being used. All such nests of both 1943 and 1949 were reasonably close to occupied nests. Three nests of the 1949 season will illustrate some possible causes for abandonment. The first nest was built in a small elm at a point where two separate uprights crossed. Apparently a strong wind had exerted sufficient pressure against the foliage to cause both sides of the nest to collapse, making it no longer habitable. Another nest in a hawthorn was attached to two separate uprights so that wind movement in the foliage above caused it to break loose from its anchorage. The third nest, built in the upper part of an osier dogwood without support at the bottom of the fork, was composed almost entirely of thistle down unbound by fibrous material. The weight of the young apparently caused the lining to drop through the flimsy outer part to the ground. I believe that it can be said that poor choice of site and the failure to adapt materials to site account for part of the nesting delays and casualties found in the Goldfinch.

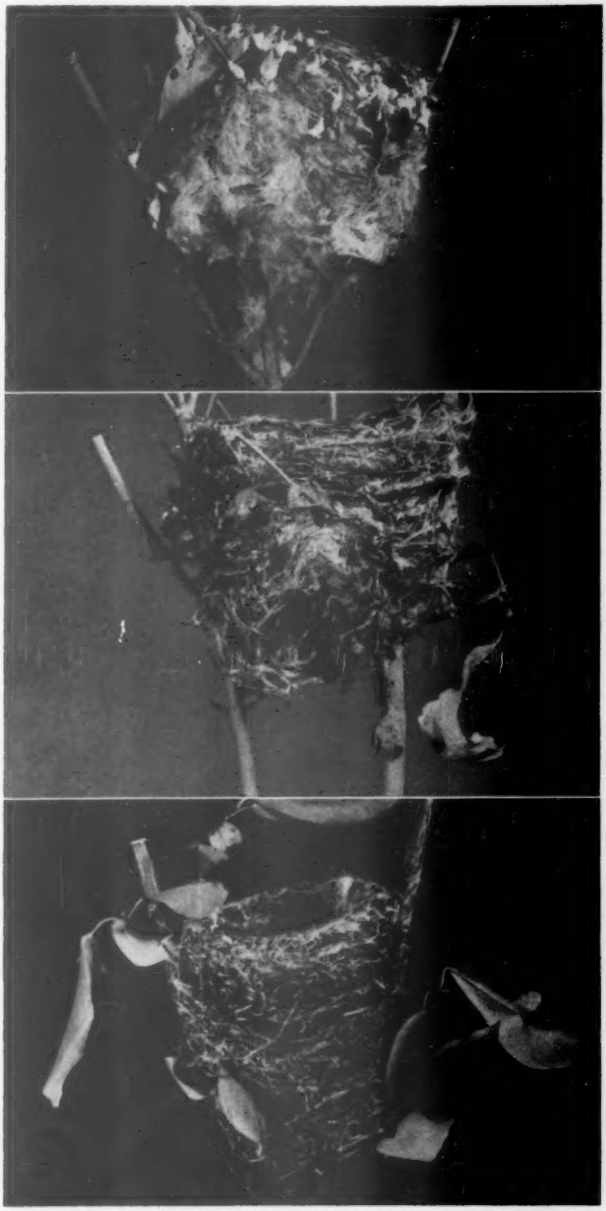
Abandonment of Young in the Nest

Apparently, Goldfinches rarely abandon young in the nest. As has been shown in this paper, nests are abandoned in all stages from mere beginnings to those with eggs under incubation. In the course of the breeding cycle the attachment of the adults normally becomes stronger as hatching time approaches, reaches its climax at the hatching of the young, and diminishes in intensity as the young approach independence. I have recorded six broods which were found dead in the nest. At Camp Sherwood, July 19, 1942, three Cowbirds, *Molothrus ater*, hatched in a Goldfinch nest. At the next observation on July 24, all young were dead. One was in the nest; the others were on the ground underneath. A female Goldfinch was seen in the vicinity but she did not go near the nest. A nest in the Cranbrook area held four 7-day Goldfinches and one infertile egg on August 8, 1943. Three days later, three of the young were dead, the fourth was dying. Neither of the adults was seen in the vicinity. Another nest at Cranbrook, September 15, 1949, contained one young about five days old and one infertile egg. The young appeared to have died two or three days before. No adults were seen. In the same area, another nest on September 21, 1949, held three 8- or 9-day young and one which had been dead three or four days. On September 23 and 25 the three young appeared about ready to fly, but on September 26 all were dead. Examination showed the crops empty. On October 23 and November 20, 1949, Harold Mahan of Ferndale, Michigan, found and brought to me two nests of the Goldfinch which held dead young.



TYPES OF NESTS OF THE EASTERN GOLDFINCH. (*Left*) TYPE 1. A DEEP NEST WITH FIVE POINTS OF ATTACHMENT OR SUPPORT. (*Middle*) TYPE 3. NEST HELD BETWEEN TWO VERTICAL SUPPORTS. (*Right*) TYPE 6. NEST SUPPORTED BETWEEN TWO HORIZONTAL BRANCHES WITH NO SUPPORT BENEATH.

TYPES OF NESTS OF THE EASTERN GOLDFINCH. (*Top*) TYPE 2. THREE POINTS OF ATTACHMENT ARRANGED ON ONE SIDE.
(*Middle*) TYPE 4. NEST IN TUFT ON HORIZONTAL BRANCH.
(*Bottom*) TYPE 5. UNDERSIDE OF NEST IN TUFT AND SADDLED OVER A BRANCH.



NESTS OF THE EASTERN GOLDFINCH. (*Top*) SHOWING NEST LACKING THE NORMAL BASKET OR OUTER BINDING.
(*Middle*) SHOWING LACK OF FORK-FILLING UNDER THE NEST.
(*Bottom*) FORK-FILLING UNDER THE NEST.

In the first nest were four birds which had been about seven to nine days old at death, judging by the plumage growth. The young in the other nest appeared to have been four or five days old at death. All nests were examined for mite infestation which, if sufficiently heavy, apparently may cause abandonment of young in other species, but there were no signs of this. No definite cause of death in any of the young could be determined.

SECONDARY USES OF NESTS

Little mention has been made in the literature of secondary uses of birds' nests. I listed (1943: 51) three secondary uses of Goldfinch nests: (1) as remodeled winter nests of white-footed deer mice, *Peromyscus leucopus*; (2) as storage places for food by red squirrels, *Tamiasciurus hudsonicus;* and (3) as "dinner tables" or feeding platforms for red squirrels, deermice, and chipmunks, *Tamias striatus*. Stokes (1950: 125) mentions abandoned Goldfinch nests which he found occupied by white-footed mice. In 1949 in the Cranbrook area I witnessed the use of two different Goldfinch nests as roosting shelters for House Wrens, *Troglodytes aëdon*. On August 30 at nightfall I found a complete but unused nest saddled on a diagonal branch of an apple tree, 7.8 feet above the ground. When I cautiously lowered the branch the wren flew out of the nest and sat near by scolding for several minutes. Two evenings later at a place about two miles away, two wrens repeated this performance at an unused nest which was four feet up in an elm.

SUMMARY

A study was made of 264 nests of the Eastern Goldfinch in three areas in Michigan during 11 seasons between 1933 and 1949. The objective was to determine the changes which have occurred in Goldfinch habitats since the settlement of the country and the relationship between individuals and their environment.

A mass of evidence indicates that the Goldfinch has extended its habitat into areas not available in primitive times. Three major types of habitats were found in the areas studied. Two types existed in precolonial times and one has developed since the forests were cleared. These habitats are forest fringes, swamps, and open uplands. The greatest concentration of nests was found in swamp habitats. Two species of herbaceous plants naturalized from Europe (the Canada thistle and common dandelion) have become important as food and nesting materials for the Goldfinch.

Goldfinch populations were found to be smaller in the Walloon Lake and Camp Ohiyesa areas than in the Cranbrook region. Also, nests were here built at much greater heights above the ground.

All major types of habitat are represented in the Cranbrook area. Hawthorns, panicled dogwood, and American and slippery elms have spread into abandoned upland areas and are illustrative of the type of habitat which has appeared in about the last 100 years.

Suitable nesting sites and proximity of food and nesting materials are believed to be important in the selection of territory. The Goldfinch does not appear to exhibit strong territorial behavior. This agrees with the studies of Walkinshaw and Nice, but does not agree with the findings of Drum and Stokes. Nests were found in greater densities in swamp areas than they were in drier habitats where shrubs were more thinly distributed.

The nesting season of the Goldfinch begins later than that of any other species of bird in Michigan. Frequently, however, the Cardinal, Cedar Waxwing, and Mourning Dove finish the nesting season later.

Nest sites in this study have been divided into six main types; three types of site are vertical and three are horizontal. Two nests were in horizontal forks resembling the nest sites of Vireos. I have never found a nest of the Goldfinch on the ground.

While a great variety of trees and shrubs and a few herbaceous plants are used as nesting sites, panicled dogwood and hawthorns were used for more than 43 per cent of all nests recorded. Two nests were found in goldenrod. Structural features consisting of three or more points of attachment were found in a large majority of nest sites. Nests were found in 17 species of shrubs, 18 species of trees, two species of vines, and two species of herbaceous plants.

The materials used in nest construction are many and varied. Any apparent specificity appears to be the result of the presence of adequate materials which meet the requirements of flexibility, strength, and softness. Outer stalk fibers of milkweeds and thistle down are used in a majority of nests. The initial steps in nest construction are thought to be partially controlled by the structural features of the site, the abundance of building materials, or the physiological urge of the female.

Nests used by young are almost invariably incrusted with droppings. A small amount of flattening of the nest rim results from the weight of the young. The flattening is greater in nests in horizontal positions, due to weakness of support at the sides. One nest was infested with mites. More than a third (38 per cent) of used nests in upright forks were deeper than wide. All nests in horizontal sites were wider than

deep. Outer dimensions of nests in upright forks appear to be partly determined by fork dimensions and an abundance of materials near by. The inner dimensions appear to be more definitely determined by the molding action of the female. An average difference of only 0.05 of an inch was found in inner diameter of fresh nests in horizontal and vertical sites.

Weights of nests showed variations because of differences in size, materials, degree of compaction, and accumulation of feather scales, excreta and other debris. Weights of nests containing heavier materials were greater in proportion to size.

Heights of nests above the ground varied with different habitats and trees and shrubs. The lowest nest was one foot and the highest 33 feet above the earth. The average height of 211 nests in all sites was 6.1 feet above the ground.

It is believed that reclaimed nesting materials are often used in nests of the Goldfinch. Four records of this behavior have been found in the literature. I reported two in 1943, Drum one in 1939, and Stokes one in 1950. Reclaimed materials used by the Goldfinch are torn from their own as well as the nests of other species.

A number of unfinished nests were abandoned. Physiological immaturity was given as a possible cause by Armstrong. Some evidence exists of other factors involved. Adverse weather, fright, too narrow sites, and other obstacles are believed to be external factors causing abandonment. Completed nests were abandoned frequently. Some apparent causes of abandonment were found in a nest which had collapsed, one which had broken loose from the anchorage, and one from which the lining had fallen. Six nests containing young were abandoned. No definite causes of death of these young could be determined.

Some nests of the Goldfinch are used secondarily as winter nests, food storage, and feeding platforms for small mammals and as nesting material for the Yellow Warbler. Two observations of use as roosting shelters by House Wrens were recorded.

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REMOVAL AND REPOPULATION OF BREEDING BIRDS IN A SPRUCE-FIR FOREST COMMUNITY

BY ROBERT E. STEWART AND JOHN W. ALDRICH

In 1949, while engaged in population studies of birds in northern Maine, the authors accumulated considerable information concerning population dynamics of birds inhabiting the Spruce-Fir forest community. This information was obtained in connection with investigations of the effective control by breeding birds of an infestation of the spruce budworm, *Choristoneura fumiferana* Clem.

Field studies were conducted during June and July on two separate areas; a square 40-acre tract which was used as an experimental area, and a rectangular 30-acre tract that served as a control area. The two areas were 1.25 miles apart and were both within one-half mile of the shore of Cross Lake, located about 14 miles southeast of Fort Kent, Aroostook County, Maine. In the experimental area an attempt was made to eliminate or to reduce drastically the bird population by use of firearms, while in the control area the natural bird population was allowed to remain unmolested. Both skins and stomachs of the birds killed were preserved for the Fish and Wildlife Service collections. The spruce budworm populations were studied in both areas before, during, and after the removal of the birds in order to see if any differential developed between the two areas in their total populations. The entomological portion of the field study was conducted by Philip B. Dowden and V. M. Carolin of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture. Stomach contents of the birds collected were analyzed by Robert T. Mitchell of the Fish and Wildlife Service. The results of the various phases of this work concerning the effective control by birds of spruce budworms will appear in a separate report. The present paper includes an analysis only of the data on removal and repopulation of birds in the experimental area.

The Spruce-Fir forest in the experimental area was somewhat varied. The canopy in certain sections of the forest had been partially opened by selective lumbering, resulting in a fairly dense understory growth of conifers. The other portions of the forest with a closed canopy contained little or no understory. Balsam fir, *Abies balsamea*, and black spruce, *Picea mariana*, were the primary dominant trees throughout the forest. The majority of the trees ranged between 40 and 60 feet in height. Small sections of mixed coniferous-deciduous

brushy undergrowth were present and the area was crossed by a state highway.

The population of territorial males in the area was determined prior to the removal of birds, by using the spot-mapping method (see Breeding-Bird Census, Audubon Field Notes, 4 (2): 185–187). Twenty-five census trips totaling 55 man-hours were conducted on the area from June 6 to June 14, inclusive. Most of the census trips were taken during early morning hours between 6:00 and 10:30 a.m. A few trips were also made in the evening for the determination of thrush populations.

Beginning on June 15 and extending through July 8, an attempt was made to remove all birds on the experimental area by shooting with 16-gauge shotguns. Shells used were loaded with very fine (No. 12) shot so that birds would not be too mutilated for specimens. By using this method the total population on the area was greatly reduced, although the actual degree of reduction could not be readily appraised. The chief difficulties were that the breeding territories were completely disrupted during the period when the original occupants were being removed and at the same time new adult males were constantly invading the area. Most of the adult females were so inconspicuous and secretive that it was not possible to census them accurately. In all, a total of about 130 man-hours were spent on the area collecting birds. The number of birds removed from this 40-acre tract during the entire collecting period was 455 (420 adults and 35 birds in juvenal or immature plumage).

Nearly all of the birds in the Spruce-Fir forests appeared to be at or near the peak of their breeding cycle during this study. With the exception of the American Crow, Golden-crowned Kinglet, and Red-breasted Nuthatch, it is doubtful if any species, at the onset of collecting, had produced nestlings. Nestlings, as well as three or four groups of fledglings, of the Golden-crowned Kinglet and Red-breasted Nuthatch were observed, but they were practically all removed from the area soon after they were first encountered during the first few days of collecting. The constant pressure of collecting and the resultant turn-over in adult birds completely prevented the development of other nestling populations in the study area during the collecting period.

Small, roving groups of adult non-breeding birds were found in the area from time to time. The most common of these were the American Robin and Cedar Waxwing, both species being occasionally represented by from one to nine individuals. These birds were noted with increasing frequency during the latter part of the collecting period,

from about July 2 to July 8. Other non-breeding birds occurring more rarely included the American Goldfinch, Pine Grosbeak, and Chipping Sparrow. A few wandering immature birds were also seen during the last few days of collecting. These had undoubtedly moved in from outside areas after having become independent of their parents. An attempt was made to collect all of these birds whenever they were encountered.

After the first nine days of collecting (June 15–June 23) the resident males of all species except the Myrtle Warbler and Olive-backed Thrush had been reduced to 15 per cent or less of the original numbers. Continued collecting coupled with a steady influx of new males maintained these species at about this level for the remainder of the collecting period. The number of male Magnolia Warblers was reduced to the 15 per cent level by June 23 even though only 16 males (67 per cent of original population) had been taken by that time. Possibly some of the males had deserted owing to the disturbance of walking and shooting in the area; the Magnolia Warbler, being an understory species, would probably be affected by such disturbance more than tree-top birds would be. The number of male Myrtle Warblers was reduced to about 25 per cent and maintained this approximate level thereafter. Apparently a proportionately larger number of non-territorial males of this species was present to fill evacuated territories. The Olive-backed Thrush was found to be a very difficult species to collect. It was much more wary and secretive than the other species and was seldom seen, although its songs and call-notes were evidence of its continual presence. Although a total of 18 adult Olive-backed Thrushes was taken during the collecting period, the rate of collection was so low and repopulation so fast that the resultant voids in the population were filled by new males almost as soon as the voids were produced. As a result, the population level for males of this species was reduced only slightly below (probably about 80 per cent of) the pre-collecting population.

The approximate reduction in total number of adult males of all species was from an average of 148 to 28 or, in other words, from a density of 370 males per 100 acres to 70 males per 100 acres (reduction of 81 per cent). This density of 70 males per 100 acres is the approximate level that was maintained from June 24 to July 8. With the exception of wandering non-breeding birds, including the Arctic Three-toed Woodpecker, Cedar Waxwing, Black-throated Green Warbler, Chestnut-sided Warbler, Pine Grosbeak, American Goldfinch, Chipping Sparrow, and most of the Robins, practically all of the adult males taken appeared to be on their breeding territories at the time they were collected.

Most of the new males which took possession of the evacuated territories probably arrived during the night or early morning, as practically all of them when first observed seemed to be actively establishing territory, and no evidence of any late arrivals during the day was noted. The males of many species appeared to be completely eradicated time after time, only to be replaced by other males on following days. The characteristic behavior pattern of most of the new arrivals was quite distinct from the behavior displayed by males with territories that had been maintained over a longer period. The songs of these newcomers were louder and uttered more frequently, while at the same time the birds were much more active in covering and inspecting the areas within their territories. It is probable that most of these new arrivals were unmated. Lack (1946) in his study of the English Robin found that "In the late spring nearly all the best robin song comes from cocks which are unmated." ". . . almost immediately after the cock has obtained a mate, its song declines to a rather moderate intensity and remains so, except during fights, unless the mate is lost, in which case the cock again comes into loud song."

Due to the variable nature and uneven growth of the Spruce-Fir forests in the area, the required habitat niches for the various resident species were not uniformly distributed. Because of this, the pre-collecting distributional pattern of breeding territories was quite different for each species. It was therefore of interest to note that subsequent to the collection of the original territorial males, the new males of each species almost invariably established territories in the same places that were occupied by their predecessors. Since an abundant food supply was available for birds throughout the area, these observations substantiate the importance of "the niche" in explaining local distribution of breeding birds.

Prior to the collecting period, the number of territorial males on the shooting area was 148, as determined by the spot-mapping method from June 6 to June 14. The number of adult males collected on the area during the period June 15 to July 8 was 302 + (Table 1). Thus, over twice as many males were removed from the area as were present before the collecting was started. The rapid influx and establishment of new territorial males, following the removal of the former occupants, account for the large number of males collected and are indicative of the amount of population pressure that was present in this community. It would appear that this pressure was due to severe competition, between individual males of the same species, for suitable areas to establish their territories. Apparently, the appropriate habitat

TABLE 1

PRE-COLLECTING POPULATION AND COLLECTION TOTALS OF ADULT MALES

Species	*Pre-collecting population, territorial males June 6-14*	*Total males collected June 15–July 8*	*Collecting periods*		
			June 15–23	*June 24–July 1*	*July 2–8*
Tetraonidae					
Ruffed Grouse, *Bonasa umbellus*	+	1	1		
Picidae					
Yellow-shafted Flicker, *Colaptes auratus*	1	2	1		1
Arctic Three-toed Woodpecker, *Picoides arcticus*	V	1		1	
Tyrannidae					
Yellow-bellied Flycatcher, *Empidonax flaviventris*	4	3 (4)	2		1
Corvidae					
Blue Jay, *Cyanocitta cristata*	1.5	2	2		
American Crow, *Corvus brachyrhynchos*	+	1 (1)		1	
Paridae					
Black-capped Chickadee, *Parus atricapillus*	2	3 (4)	3		
Brown-capped Chickadee, *Parus hudsonicus*	2.5	3 (5)	3		
Sittidae					
Red-breasted Nuthatch, *Sitta canadensis*	3.5	4 (1)	4		
Troglodytidae					
Winter Wren, *Troglodytes troglodytes*	2	1	1		
Turdidae					
American Robin, *Turdus migratorius*	2	14 (4)	4	4	6
Hermit Thrush, *Hylocichla guttata*	2	4	2	2	
Olive-backed Thrush, *Hylocichla ustulata*	7.5	11 (2)	4	2	5
Regulidae					
Golden-crowned Kinglet, *Regulus satrapa*	4	4	3	1	
Ruby-crowned Kinglet, *Regulus calendula*	2	2	2		
Bombycillidae					
Cedar Waxwing, *Bombycilla cedrorum*	V	6 (2)			6
Vireonidae					
Solitary Vireo, *Vireo solitarius*	3	4 (1)	3	1	
Red-eyed Vireo, *Vireo olivaceus*	1.5	7	2	3	2
Parulidae					
Tennessee Warbler, *Vermivora peregrina*	3	1	1		
Nashville Warbler, *Vermivora ruficapilla*	4	6	5		1
Parula Warbler, *Parula americana*	1	4	2		2
Magnolia Warbler, *Dendroica magnolia*	24	36	16	10	10
Cape May Warbler, *Dendroica tigrina*	12	23	13	10	
Myrtle Warbler, *Dendroica coronata*	8.5	29	11	9	9
Black-throated Green Warbler, *Dendroica virens*	V	1		1	
Blackburnian Warbler, *Dendroica fusca*	9	15	7	2	6
Chestnut-sided Warbler, *Dendroica pensylvanica*	V	1		1	
Bay-breasted Warbler, *Dendroica castanea*	35	81	34	21	26
Oven-bird, *Seiurus aurocapillus*	1.5	1	1		
Canada Warbler, *Wilsonia canadensis*	.5	1	1		
Fringillidae					
Purple Finch, *Carpodacus purpureus*	2.5	6	3	1	2
Pine Grosbeak, *Pinicola enucleator*	V	3			3
American Goldfinch, *Spinus tristis*	V	2			2
Slate-colored Junco, *Junco hyemalis*	5	13 (6)	6	2	5
Chipping Sparrow, *Spizella passerina*	V	1 (1)			1
White-throated Sparrow, *Zonotrichia albicollis*	3.5	5 (3)	5		
TOTAL	148	302 (34)	142	72	88

( ) undetermined sex V visitor in area

+ indicates that less than .25 of one territory was present on area.

niches for most species were not numerous enough to satisfy the territorial requirements of all the males present.

The indications are that a large, surplus, "floating" population of unmated males must have been present in the Spruce-Fir forests of this region. Since there was no evidence that spring migration was still continuing at the time the collecting was initiated, it was assumed that the birds which invaded the area were largely unmated wandering males that had been in the general region for some time. Presumably these males were searching for suitable sites to establish territories, and whenever unoccupied habitat of the right type was found they lost little time in taking over and proclaiming their ownership by song. This is in line with the belief of Nice (1941) that "birds which fail to obtain territory, form a reserve supply from which replacements come in case of death of owners of territory." In a study of the territories of Marsh Tits, Southern (1950) stated that "the speed with which deaths among the breeding population were replaced suggests that there was definitely a non-breeding population throughout the spring."

It is probable that at least some of the new males that were collected were those that had established territories in areas adjacent to the collecting area. Upon the removal of the original territorial males in the collecting area, some of the males in outside areas could have taken advantage of the reduction in population pressure and expanded the boundaries of their territories into the collecting area. In a study of banded English Robins, Lack (1946) found that "when the owner of a territory disappears, the owners of the neighboring territories expand into the vacant site almost at once, and often the ground is fully occupied within twenty-four hours." In a comprehensive study of Ruffed Grouse, Bump, *et al.* (1947) discovered that the birds "tend quite rapidly to move into a covert whose population has been depleted out of proportion to those surrounding it." In the present study, however, the fact that more new males first appeared in the center of the collecting area than on the periphery would indicate that most of them were wandering, unmated birds rather than neighbors expanding their territories.

The ratio of males collected to the number of territorial males on the area prior to the collecting period was found to vary considerably with different species. In the case of birds belonging to Old World families such as the kinglets, chickadees, and nuthatches, there was very little difference between the two figures, indicating that their populations were comparatively stable. However, for most of the thrushes, vireos, warblers, and fringillids, the number of males collected was from one and one-half to three times as great as the number present in the area

before collecting. The Red-eyed Vireo showed the greatest difference of all with nearly five times as many males collected as were formerly present in the area (the relatively high numbers of American Robins and Cedar Waxwings that were collected were due to the presence of wandering non-territorial birds). These striking differences in ratios of individuals present before collection to those collected for the different species would seem to indicate that the surplus of males was much greater for some than for others. In the case of Brown-capped Chickadees, American Robins, Golden-crowned Kinglets, and Red-breasted Nuthatches, it is possible that because of their earlier period of nesting they might have passed that stage in their breeding cycle at which they were interested in establishing territories and, therefore, the number of individuals present before collecting was relatively similar to the number collected.

Differences in the ratio of males collected to number of males present in the area before collecting were quite pronounced even among species that were closely related and that had similar habits. The five most abundant species in the area were warblers, all belonging to the genus *Dendroica*. The number of males collected for every male that was present in the area before collecting is indicated for each of these species, as follows: Magnolia Warbler, 1.5; Blackburnian Warbler, 1.7; Cape May Warbler, 1.9; Bay-breasted Warbler, 2.3; and Myrtle Warbler, 3.4. Since these species are about equally conspicuous in the field, it is unlikely that such noticeable differences in the ratios can be attributed to variations in the ease with which they may be collected.

Those species that showed a definite surplus of males could be considered as having *supersaturated* populations (see Kendeigh, 1947). In other words for these species, the carrying capacity of the area, insofar as breeding territories were concerned, was insufficient to take care of the needs of all males present. Possibly, the presence of the infestation of spruce budworms could have accounted for this. The great abundance of food resulting from the budworm infestation might have attracted such a large number of males to the area that the territorial requirements of all of them could not be satisfied. The importance of territorial behavior in limiting bird population in a given habitat is stressed by Nice (1937) who stated, however, that "climate and other factors may keep the numbers of a species in a region so low that territorial behavior has no chance to limit populations." Thus, while various factors may affect the numbers of breeding birds occurring in an area, the true balancing agent between bird populations and environment is the competition for territories among

individual males of the same species. This is in accord with the findings of Nicholson (1933) who wrote "for balance, it is essential that the action of a controlling factor should be governed by the density of the population controlled, and competition seems to be the only factor that can be governed in this way."

It would seem probable that when certain elements, such as food supply, in the habitat vary, the saturation point for each species will vary also. For example, the saturation point for most insectivorous birds in a Spruce-Fir forest without a budworm infestation would probably be much lower than it was in the area studied. This belief is based on the assumption that the minimum territorial requirements are affected by the relative ease with which food can be obtained. Kendeigh (1947) has pointed out that in the case of the Tennessee, Cape May, and Bay-breasted warblers there appears to be a direct correlation between the abundance or occurrence of these species and the severity of spruce budworm infestations. The principle of balance between changing animal populations and environment was expounded by Nicholson (1933) who stated that "if a population is in a state of balance with the environment, its density must necessarily change in relation to any changes in the environment." This principle is further clarified by Elton (1936) who maintained that "the chief cause of fluctuations in animal populations is the instability of the environment."

The number of adult breeding females was also greatly reduced during the collecting period, although the actual degree of reduction could not be determined from the data available. The small number of females recorded at any time was somewhat puzzling. Although female birds are generally much more difficult to observe in the field than are males, the exceedingly small number actually seen and collected over a three-week period would, assuming that most males had been mated, indicate that a preponderance of the females deserted the area shortly after their mates had disappeared. The close attachment to the nests and general inconspicuousness of most females undoubtedly explains in part why such a small number was seen and collected during the first few days. The presence of large numbers of conspicuous territorial males at that time would naturally tend to overshadow the count of the females. However, the continued recording of low numbers of females following the initial period of collecting is thought to be due, in large part, to an extensive withdrawal of females from the area. After the majority of the males had been collected, any type of bird activity, slight though it might be, became much more noticeable; thus the presence of any appreciable number

of females would surely have been noted. At least 130 man-hours were spent in the area during the collecting period and practically all of the females seen were collected (Table 2). The females collected had well developed brood-patches on their breasts, indicating that they either were or had been sitting on eggs. If females had remained undetected in the area and continued to sit on eggs throughout the period, many of them would have been feeding young before the period was over and, therefore, would have become much more conspicuous at that time. The females of the later-breeding species did not become conspicuous at any time, and there was no evidence of young produced on the shooting area.

Certain species showed a much greater disparity in the proportions of the sexes seen and collected than others (Table 2). The greatest differences in the ratio of the sexes were found in the warblers (Parulidae) and vireos (Vireonidae). In the case of the warblers, the males of which comprised about 67 per cent of the total adult male population of all species, only 29 (13 per cent) of 228 adults collected proved to be females. For most birds, other than the warblers and vireos, the females were observed nearly as often as the males and were almost as readily collected from the start. It would seem to be significant that several species, of which almost equal numbers of males and females were collected, were earlier breeders which were caring for young at the time collecting began. This fact could be responsible for the females, being more conspicuous and more readily collected. It is well known also that females desert their nests and territories more readily before incubation becomes well advanced.

Variations in the sex ratios of the birds collected may be indicative of actual differences in sex ratios of certain of the species represented. The sex ratios, of birds collected, for the seven most abundant species are indicated as follows (ratio of males to females): Blackburnian Warbler, 15–1; Bay-breasted Warbler, 9–1; Magnolia Warbler, 6–1; Cape May Warbler, 6–1; Myrtle Warbler, 6–1; Slate-colored Junco, 2.5–1; Olive-backed Thrush, 2–1. It is unlikely that such marked differences as these could be due entirely to differences in comparative conspicuousness between males and females of the species listed.

SUMMARY

The number of territorial male birds in a 40-acre tract of Spruce-Fir forest in northern Maine was 148 during the period June 6 to June 14, 1949. Birds were removed from this area by shooting from June 15 to July 8, inclusive, with the intention of reducing the population to and keeping it at as low a level as possible. By this means the number

TABLE 2

NUMBERS OF ADULT MALES AND FEMALES COLLECTED

Species	*Males*	*Females*	*Undetermined sex*[1]
Tetraonidae			
Ruffed Grouse	1	1	
Picidae			
Yellow-shafted Flicker	2		
Arctic Three-toed Woodpecker	1		
Tyrannidae			
Yellow-bellied Flycatcher	3		4
Corvidae			
Blue Jay	2	1	
American Crow	1		1
Paridae			
Black-capped Chickadee	3	1	4
Brown-capped Chickadee	3	4	5
Sittidae			
Red-breasted Nuthatch	4	6	1
Troglodytidae			
Winter Wren	1	1	
Turdidae			
American Robin	14	11	4
Hermit Thrush	4		
Olive-backed Thrush	1	5	2
Regulidae			
Golden-crowned Kinglet	4	4	
Ruby-crowned Kinglet	2	1	
Bombycillidae			
Cedar Waxwing	6	2	2
Vireonidae			
Solitary Vireo	4	1	1
Red-eyed Vireo	7		
Parulidae			
Tennessee Warbler	1	1	
Nashville Warbler	6		
Parula Warbler	4		
Magnolia Warbler	36	6	
Cape May Warbler	23	4	
Myrtle Warbler	29	5	
Black-throated Green Warbler	1		
Blackburnian Warbler	15	1	
Chestnut-sided Warbler	1		
Bay-breasted Warbler	81	9	
Oven-bird	1	3	
Canada Warbler	1		
Fringillidae			
Purple Finch	6	3	
Pine Grosbeak	3	1	
American Goldfinch	2	3	
Slate-colored Junco	13	5	6
Chipping Sparrow	1		1
White-throated Sparrow	5	5	3
TOTAL	302	84	34

[1] Many birds lodged in tree-tops at time of collecting and were not examined closely.

of territorial males was reduced to approximately 19 per cent of the original by June 24. Continued collecting coupled with a steady influx of new birds maintained this low level until July 8. A total of 455 birds (420 adults and 35 young) were removed from the area during the entire collecting period.

Following the collection of the resident males, new males entered the area either during the night or early morning. The behavior of the new arrivals differed from the older residents in that they were much more active and vocal, singing more vigorously and more frequently. The importance of habitat niches in controlling the distribution of most species was indicated by the fact that most of the new arrivals established themselves in the same places that had been occupied by former residents of the same species.

For most species, over twice as many adult males were collected on the area as were present before the collecting started. This was due to the rapid influx and establishment of new territorial males following the removal of the original occupants. The carrying capacity of the forest from the standpoint of suitable sites to establish territories was not sufficient to accommodate all the males present, resulting in a surplus population. These surplus birds served as a reserve supply, replenishing areas that had been depleted. Some of the additional males collected were probably those that had territories adjacent to the shooting area, since the reduction in population pressure in the area due to collecting would permit an expansion of their territories into the shooting area. However, it is believed that the majority of evacuated territories were filled by entirely new birds. A few species were represented in the area only by wandering non-breeding birds.

The ratio of males collected to the number of territorial males on the area prior to collecting varied considerably with different species. The competition for territories among individual males of the same species appears to be the balancing agent between the size of bird populations and environment.

The number of adult females of later-breeding species collected was much less than the number of males. Although the general inconspicuousness of most breeding females undoubtedly explains in part why such small numbers were collected, there is evidence that a majority of the females in these species deserted the area after their mates had disappeared. The greatest differences in the ratios of the sexes collected occurred in the warblers (Parulidae) and vireos (Vireonidae).

In general, the later-breeding species, such as warblers, vireos, and thrushes, showed a greater disparity in the sexes of collected speci-

mens than did the earlier breeders, such as the chickadees, nuthatches and kinglets. This condition seemed to be correlated with the fact that these earlier breeders did not refill evacuated territories to nearly the extent that the later breeders did. This could indicate a smaller reservoir of non-territorial birds and thus a lower population pressure in these species; or it could be the result of a more advanced condition of the breeding cycle during which the instinct to establish territory is absent or diminished in intensity.

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FURTHER DATA ON REMOVAL AND REPOPULATION OF THE BREEDING BIRDS IN A SPRUCE-FIR FOREST COMMUNITY

BY M. MAX HENSLEY AND JAMES B. COPE

DURING June and July of 1950 the writers were engaged in a study of bird populations in northern Maine in conjunction with investigations to determine the effectiveness of the breeding bird population as a controlling agent of the spruce budworm, *Choristoneura fumiferana*. The field work was started in 1949 and the current project was a continuation. The entomological phase of the study during both seasons was conducted under the supervision of Philip B. Dowden and V. M. Carolin of the Bureau of Entomology and Plant Quarantine; the initial bird population study was made by John W. Aldrich and Robert E. Stewart of the Fish and Wildlife Service (See page 471 of this issue of 'The Auk').

Many data were accumulated concerning bird population dynamics during the initial study. To compare the results of the two seasons and to present other significant facts, additional data are presented here.

The study was conducted in the same 40-acre tract of spruce-fir forest that was established as the experimental area during 1949. Balsam fir, *Abies balsamea*, and black spruce, *Picea mariana*, were the predominant trees in the area and ranged from 40 to 60 feet in height. The vegetation complex was somewhat varied due to selective cutting in several small sections of the forest. This resulted in a rather dense undergrowth of conifers. Where the canopy was unbroken very little understory was present. The area was crossed by a state highway.

An attempt was again made to eliminate, or to reduce drastically, the bird populations on the experimental area which was then closely studied to determine any difference in the numbers of budworms. Stomachs of most of the birds collected were preserved, and an analysis of their contents was made by Robert T. Mitchell of the U. S. Fish and Wildlife Service.

Prior to the collecting period a series of bird censuses was conducted to determine the breeding bird population of the area. The spot-mapping method (Aud. Field Notes, 4 (2): 185–187, 1950) was utilized for this phase of the work. A total of 28 censuses involving 45 man-hours was taken from June 6 to June 13, inclusive. Most of the trips were made between 6:00 a. m. and 10:30 a. m. with the exception

TABLE 1

ADULT BIRDS REMOVED FROM EXPERIMENTAL AREA, SHOWING TENDENCIES OF THE VARIOUS SPECIES TO MOVE INTO THE AREA

	Breeding population (males)		*Breeding birds removed*				*Ingressing birds removed*				*Undetermined birds removed*		*Total collected*	
			Males		*Females*		*Males*		*Females*					
	1949	*1950*	*1949*	*1950*	*1949*	*1950*	*1949*	*1950*	*1949*	*1950*	*1949*	*1950*	*1949*	*1950*
Bay-breasted Warbler, *Dendroica castanea*	35	34	35	34	9	16	46	48	—	—	—	—	90	98
Magnolia Warbler, *Dendroica magnolia*	24	18.5	24	17	6	6	12	—	—	—	—	—	42	23
Cape May Warbler, *Dendroica tigrina*	12	12	12	12	4	3	11	2	—	—	—	—	27	17
Blackburnian Warbler, *Dendroica fusca*	9	13	9	13	1	5	6	—	—	—	—	—	16	18
Myrtle Warbler, *Dendroica coronata*	8.5	10	8.5	10	5	5	20.5	17	—	—	—	3	34	35
Olive-backed Thrush, *Hylocichla ustulata*	7.5	13.5	7.5	13.5	5	8	3.5	1.5	—	—	2	—	18	23
Slate-colored Junco, *Junco hyemalis*	5	7.5	5	7.5	5	3	8	7.5	—	—	6	3	24	21
Yellow-bellied Flycatcher, *Empidonax flaviventris*	4	3.5	3	3.5	—	2	—	2.5	—	—	4	—	7	8
Golden-crowned Kinglet, *Regulus satrapa*	4	8.5	4	8.5	4	5	—	6.5	—	—	—	4	8	24
Nashville Warbler, *Vermivora ruficapilla*	4	4.5	4	4.5	—	4	2	4.5	—	—	—	—	6	13
Red-breasted Nuthatch, *Sitta canadensis*	3.5	2	3.5	1	3.5	—	.5	—	2.5	—	1	—	11	1
White-throated Sparrow, *Zonotrichia albicollis*	3.5	5	3.5	5	3.5	3	1.5	2	1.5	—	3	2	13	12
Solitary Vireo, *Vireo solitarius*	3	1.5	3	1.5	1	1.5	1	6.5	—	.5	1	—	6	10
Tennessee Warbler, *Vermivora peregrina*	3	3	1	3	1	3	—	2	—	2	—	—	2	10
Brown-capped Chickadee, *Parus hudsonicus*	2.5	1	2.5	1	2.5	1	.5	1	1.5	1	5	2	12	6
Purple Finch, *Carpodacus purpureus*	2.5	2	2.5	2	2.5	2	3.5	37	.5	16	—	7	9	64
Black-capped Chickadee, *Parus atricapillus*	2	—	2	—	1	—	1	3	—	1	4	—	7	4
Ruby-crowned Kinglet, *Regulus calendula*	2	2	2	2	1	2	—	3	—	1	—	—	3	8
Winter Wren, *Troglodytes troglodytes*	2	1.5	1	1.5	1	1.5	—	3.5	—	.5	—	—	2	7
American Robin, *Turdus migratorius*	2	4	2	4	2	2	12	3	9	—	4	7	29	16
Hermit Thrush, *Hylocichla guttata*	2	1	2	1	—	1	2	2	—	1	—	—	4	5
Blue Jay, *Cyanocitta cristata*	1.5	1.5	1.5	1.5	1	1	.5	3.5	—	—	—	—	3	6
Red-eyed Vireo, *Vireo olivaceus*	1.5	1	1.5	1	—	1	5.5	5	—	1	—	—	4	8
Oven-bird, *Seiurus aurocapillus*	1.5	—	1.5	—	1	—	1.5	—	—	—	—	—	4	—
Northern Flicker, *Colaptes auratus*	1	.5	1	.5	—	.5	1	2.5	—	.5	—	—	2	4
Parula Warbler, *Parula americana*	1	2	1	2	—	1	3	3	—	—	—	—	4	6
Canada Warbler, *Wilsonia canadensis*	.5	+	.5	—	—	—	.5	1	—	3	—	—	1	4

TABLE 1—*Continued*

	Breeding population (males)		*Breeding birds removed*				*Ingressing birds removed*				*Undetermined birds removed*		*Total collected*	
			Males		*Females*		*Males*		*Females*					
	1949	*1950*	*1949*	*1950*	*1949*	*1950*	*1949*	*1950*	*1949*	*1950*	*1949*	*1950*	*1949*	*1950*
Ruffed Grouse, *Bonasa umbellus*	+	—	—	—	—	—	1	—	1	—	—	—	2	—
American Crow, *Corvus brachyrhynchos*	+	+	—	—	—	—	1	1	1	1	—	—	2	2
Chestnut-sided Warbler, *Dendroica pensylvanica*	+	—	—	—	—	—	1	—	—	—	—	—	1	—
Hairy Woodpecker, *Dendrocopos villosus*	—	V	—	—	—	—	—	2	—	1	—	—	—	3
Gray Jay, *Perisoreus canadensis*	—	V	—	—	—	—	—	3	—	3	—	9	—	15
Veery, *Hylocichla fuscescens*	—	—	—	—	—	—	—	2	—	—	—	—	—	2
Cedar Waxwing, *Bombycilla cedrorum*	V	V	—	—	—	—	6	15	2	6	2	11	10	32
American Redstart, *Setophaga ruticilla*	—	—	—	—	—	—	—	—	—	1	—	—	—	1
Pine Grosbeak, *Pinicola enucleator*	V	V	—	—	—	—	3	2	1	1	—	—	4	3
Eastern Goldfinch, *Spinus tristis*	V	V	—	—	—	—	2	1	3	—	—	—	5	1
Arctic Three-toed Woodpecker, *Picoides arcticus*	—	V	—	—	—	—	1	3	—	2	—	—	1	5
Chipping Sparrow, *Spizella passerina*	—	—	—	—	—	—	—	—	—	1	1	—	1	1
Eastern Wood Pewee, *Contopus virens*	—	1	—	—	—	—	—	—	—	—	—	—	—	1
White-winged Crossbill, *Loxia leucoptera*	—	—	—	—	—	—	—	4	—	2	—	1	—	7
Bronzed Grackle, *Quiscalus quiscula*	—	—	—	—	—	—	—	—	—	1	—	—	—	1
Least Flycatcher, *Empidonax minimus*	—	—	—	—	—	—	—	—	—	1	—	—	—	1
Black and White Warbler, *Mniotilta varia*	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Sharp-shinned Hawk, *Accipiter striatus*	—	—	—	—	—	—	—	—	—	1	—	—	—	1
TOTAL	148	154	144	150.5	60	77.5	160	201.5	22	48.5	34	49	420	528

A "+" sign indicates that less than 0.25 of a territory was present on the area and "V" denotes those species nesting in the general vicinity but only occasionally recorded on the area.

of a few which were taken during the late evening when the thrushes are usually more vocal.

From June 14 through June 10, a total of 322 man-hours was spent in a concentrated effort to eliminate as many birds as possible from the area by shooting with a 16-gauge shotgun. A combined total of 527 adult birds was taken during 1950, as contrasted to 420 collected the previous year, an increase of 107 individuals. Combining the two seasons gives a grand total of 947 birds removed from the 40-acre tract during the two consecutive breeding seasons. A combined total of 49 collecting days was involved.

The breeding population was remarkably similar during the two consecutive nesting seasons (Table 1). A slight increase in overall populations was apparent during the second season and was noted in two additional check areas studied, as well as in the experimental plot. Whether this increase was due to an increase in the budworm populations is not known. It is interesting to note, furthermore, that no nestlings, except those of the American Crow, Golden-crowned Kinglet, and Red-breasted Nuthatch, were raised on the area during 1949. The effect of the collecting during 1949 was not apparent, in any way, on the breeding population in the experimental area, which indicated the same population tendencies as did the check areas. The species composition and populations of the major breeding species were quite similar (Table 1), with the exception of the Olive-backed Thrush which almost doubled in density (7.5 to 13.5 pairs) over 1949, and the Magnolia Warbler which dropped from 24 to 18.5 pairs on the 40-acre tract.

During the 1949 studies about two times as many males were removed as were originally found with established territories. The 1950 season produced two and a quarter times as many. This corroborates the data of Stewart and Aldrich who concluded that a large surplus "floating" population was apparently present. Practically all of the 1949 males were territorial birds, while in the following season many more wandering non-territorial males were taken. Moffat (1903) suggested that there is a large reserve of unmated birds of both sexes ready to replace losses of birds on territories. Nice (1937), on the other hand, found very little evidence of this phenomenon with Song Sparrows; only two cases were noted of banded males serving as a reserve supply for females in need of mates. In his study of the bird populations during a spruce budworm outbreak in Ontario, Kendeigh (1947) found a larger number of birds recorded in some areas that remained to nest, citing one instance of five extra Bay-breasted Warblers in an area where 18 pairs had become established

for nesting. He further suggested that these birds, particularly younger individuals, tend to shift around and occupy various habitats to the extent of the attractiveness of the habitat, nesting only if suitable conditions prevail. This is essentially the motivating factor responsible for ingression. Speaking in relation to insects, Thompson (1930) suggested that if the population is smaller than the area might support, the gaps soon fill in from the outside. It is apparent, then, that the presence of this reserve or surplus of individuals has long been recognized, but its extent, as compared to the established breeding populations, is little understood.

Considering only the breeding population of the experimental area, an attempt was made in Table 1 to estimate the extent of ingress for the various species during the two years. All birds removed in excess of the pre-collecting population, where numbers were obtained by censusing, were considered as ingressing individuals. In cases where the breeding population (Table 1) was expressed by a decimal figure, and all these individuals were removed, instances of fractional numbers of birds collected are listed. This, of course, does not mean that a half-bird was collected but indicates that either one or both sexes of the pre-collecting component was completely removed. The possibility exists, also, that a few of the original occupants may have deserted their territories and were not collected, thus introducing a slight discrepancy in this ingressing component. The picture is somewhat further distorted by species such as the Purple Finch and Cedar Waxwing which invaded the area in considerably larger numbers than during the previous season. This can perhaps be attributed first to the somewhat abnormal weather conditions during the current study, which retarded the budworm activity to the extent that collecting had to be continued two days longer, and secondly to the fact that these species are subject to sporadic movements. By the end of the collecting period the Cedar Waxwings were commencing preliminary nesting activities in increasing numbers. Moreover, an early warm spell during late May stimulated the early-nesting Purple Finches to breed even earlier, with the result that many family flocks constantly invaded the area during the last few days of the collecting period. For the majority of the remaining species, however, a slight increase was also indicated. Of 13 species showing no increase, about half were less abundant on the area during the current season. Due to weather conditions indicated above, some 12 species managed to fledge young, as compared to only three species during the preceding year.

The problem of whether the "floating" populations, which were in evidence during the two seasons, were made up of a surplus of unmated birds or whether, in effect, migration was still underway at the time must be considered. It is conceivable that some individuals of a species could be nesting while migration of that species was still in progress (Kendeigh, 1947). In "A Summary of Spring Migration 1889–1938" (U. S. Fish and Wildl. Serv. Mem. No. 6, 1940) the average date of earliest arrivals during that 50-year period for the nesting species of Scotch Lake, New Brunswick, ran from three to four weeks earlier than the date collecting was commenced on the experimental area at Fort Kent. In fact, intensive ingression did not begin until about one week after collecting began or until June 21. This meant at least a 27-day differential between the average earliest date of arrival at the Scotch Lake area and the date of the initial intensive period of ingression at Fort Kent. During the 1949 collecting period no appreciable difference or change in the rate of ingression was noticeable. Cooke (1929) recorded certain migrating species as lingering as long as six weeks. Trautman (1940) confirmed this fact. It must be remembered, however, that these are migrating species and as they get farther northward the migration is speeded up as nesting activities become more "urgent" (Allen, 1930). It is the authors' belief, on the basis of the circumstances mentioned above and of field observations, that migration for the most part was negligible at the time collecting had begun and that the great number of birds removed represented an ingress rather than migratory activity. The unusually large number of ingressing individuals recorded July 5 was not likely to have been the result of migration at that date.

As noted previously, the ratio of males collected to the number of territorial males on the area prior to the collecting period was found to vary considerably with different species. The Red-eyed Vireo again showed the greatest difference, with six times as many males collected as were present originally. The ratio for this species in 1949 was about five to one. In so far as the five most abundant warbler species were concerned, considerable differences were noted in some cases. The comparative ratios are listed as follows with the 1949 figure mentioned first: Magnolia Warbler, 1.9–1.0; Blackburnian Warbler, 1.7–1.0; Cape May Warbler, 1.9–1.1; Bay-breasted Warbler, 2.3–2.3; and Myrtle Warbler, 3.4–2.7. All species, with the exception of the Bay-breasted Warbler, showed a marked decrease in the number of males taken per "pre-collecting" male present. Whether or not this significant decrease is due to the collecting of the previous year, which may have created an excessive unreplenished drain on the

surplus population, is hypothetical. However, the individuals occupying the niches made available by the 1949 collecting and which comprised part of the breeding population of the 1950 season probably were members of this floating aggregation. Once they found niches the following year and vacated the ranks of the reserve population, their change of status diminished the numbers of this reserve supply of potential breeding birds, which may not be as readily replenishable. The effect of the concentrated removal then is noticeable in the "floating" population which may act as a buffer during catastrophic periods, but which would be seriously affected by a continued series of unfavorable circumstances that demanded more replacements than could be produced by the reserves. Only continued longer term studies of this nature could provide a more enlightened picture of the overall effect on the bird populations as a whole. The fact that the most abundant species, the Bay-breasted Warbler, appeared to be unaffected indicates that a more substantial number of non-breeding individuals of the species may be available and only a continued unfavorable drain on the supply would appear noticeable.

A total of 108 more birds was collected during the 1950 season, including 48 more males and 44 more females. The presence of substantially larger numbers of individuals of the sporadically occurring species (Purple Finch, Cedar Waxwing, White-winged Crossbill) during the current season accounts largely for the difference. Some 16 more, unidentified as to sex, individuals were taken. This increase of 48 more males collected probably is due to the presence of the higher population level and two collectors on the area during the 1950 study. The increase in the number of females taken can be partially accounted for by the additional collector or it can more probably be attributed to the advanced stage of nesting during the latter study. Nesting activities were considerably advanced over the 1949 season, by at least a week, due to the extended warm spell in late May. Females are less inclined to desert and leave the area as the nesting season advances. Therefore, the disturbance created did not affect them as drastically as it would have had the nesting not been so far along; thus they remained on the area and were subjected to collecting for a longer period of time.

The overall sex ratio in the birds collected varied considerably between the two seasons. In 1949 there was a 3.7 to 1 ratio of males to females taken, as contrasted to the 2.8 to 1 ratio existing in 1950. The difference is due, primarily, to an increase in the numbers of females collected in 1950.

The sex ratios varied greatly from species to species, as was found by Stewart and Aldrich, with the greatest disparity occurring in the warblers (Parulidae) and vireos (Vireonidae). A total of 226 warblers was collected, of which 49 (21 per cent) were females. This figure is higher than the 13 per cent determined during the 1949 season for the same group of birds.

As a means of comparing the sex ratios, the individuals of the six most abundant species during both seasons are tabulated as follows with the first set of numbers indicating the 1949 ratio: Blackburnian Warbler, 15 : 1 and 3 : 1; Bay-breasted Warbler, 9 : 1 and 5 : 1; Magnolia Warbler, 6 : 1 and 3 : 1; Cape May Warbler, 6 : 1 and 5 : 1; Myrtle Warbler, 6 : 1 and 6 : 1; and Olive-backed Thrush, 2 : 1 and 2 : 1. Each, with the exception of the Myrtle Warbler and Olive-backed Thrush, shows a distinct reduction from the 1949 figure as regards the number of males. It is not likely, moreover, that the differences in the ratios listed are due entirely to variation in the conspicuousness of the sexes.

The population trend on the experimental area during the collecting period (Table 2) was subject to considerable fluctuation. An attempt was made to maintain the population at a minimum low level. However, it was found impossible to reduce the total numbers below 20 per cent of the original population and it was difficult to hold at that concentration. Much of the ingress occurred during the night or early morning. The behavior of the new males was distinctly different from that of males having had territories for a longer period of time. The songs of the new arrivals were louder and uttered more frequently, and the individuals were more active in inspecting the territory. Their activity was similar to the characteristic behavior of spring arrivals on the breeding ground. The rôle of ecological niches in the local distribution of breeding birds becomes rather apparent. The newcomers established territories in the same areas as their predecessors.

Tabulations of individuals recorded on six weekly census trips (June 21, 28, and July 5) during the collecting period are presented in Table 2. The censuses were made in the early morning and include the newly ingressed individuals as well as those birds surviving the collecting of the preceding day. To gain a more accurate picture of the stable population present on the area, all males collected on the census days were subtracted from the number of territories recorded on the same day. By combining this figure with daily observation notes, a somewhat reliable estimate of the birds persisting on the area could be made (Table 2). On the July 5 census a substan-

TABLE 2

POPULATIONS ON THE EXPERIMENTAL AREA BEFORE, DURING, AND AFTER THE COLLECTING PERIOD, JUNE 14–JULY 10, SHOWING THE NUMBER OF ADULT BIRDS REMOVED ON THE CENSUS DAYS

Species	*Pre-collecting June 13*	*Collecting period June 21*	*June 28*	*July 5*	*Post-collecting July 11*
Bay-breasted Warbler	34	9	8	14	5
Magnolia Warbler	18.5	6	5	5	6
Olive-backed Thrush	13.5	2	3	9	5
Blackburnian Warbler	13	2	3	9	5
Cape May Warbler	12	4	1	4	—
Myrtle Warbler	10	3	2	3	1
Golden-crowned Kinglet	8.5	1	5	1	1
Slate-colored Junco	7.5	3	3	—	2
White-throated Sparrow	5	3	2	2	—
Nashville Warbler	4.5	3	4	3	1
American Robin	4	1	4	2	2
Yellow-bellied Flycatcher	3.5	1	—	2	1
Tennessee Warbler	3	—	—	1	—
Purple Finch	2	—	2	2	2
Ruby-crowned Kinglet	2	—	—	—	—
Parula Warbler	2	1	2	1	2
Red-breasted Nuthatch	2	—	—	—	—
Solitary Vireo	1.5	—	—	1	—
Winter Wren	1.5	2	3	3	4
Blue Jay	1.5	1	—	—	—
Brown-capped Chickadee	1	—	—	1	1
Hermit Thrush	1	—	1	—	—
Wood Pewee	1	—	—	—	1
Red-eyed Vireo	1	—	1	—	—
Yellow-shafted Flicker	.5	—	1	3	—
Black-capped Chickadee	+	—	—	2	—
Canada Warbler	+	—	—	1	1
Ruffed Grouse	+	—	—	—	—
American Crow	+	—	—	1	—
Chestnut-sided Warbler	+	—	1	—	—
Brown Creeper	V	—	—	—	—
Hairy Woodpecker	V	—	—	—	—
Gray Jay	V	—	1	—	—
Cedar Waxwing	V	1	2	1	—
American Redstart	V	—	—	—	—
Evening Grosbeak	V	—	—	—	—
Pine Grosbeak	V	—	—	—	—
American Goldfinch	V	—	—	—	—
Arctic Three-toed Woodpecker	V	—	—	—	—
Northern Yellow-throat	V	—	—	—	—
Broad-winged Hawk	V	—	—	—	—
Black and White Warbler	V	—	—	—	—
Indigo Bunting	V	—	—	—	1
White-winged Crossbill	—	—	—	—	4
TOTAL MALES RECORDED IN CENSUS	*154*	*42*	*52*	*63*	*40*
TOTAL MALES REMOVED ON CENSUS DAYS	—	*9*	*21*	*16*	—
NET NUMBER OF MALES REMAINING	—	*33*	*31*	*47*	—
PER CENT OF ORIGINAL POPULATION REMAINING	—	*21*	*20*	*30*	—

tially larger number of territorial males was recorded, which was due to the unusually large number of ingressing individuals appearing on the area during the two preceding days. On these two days a total of 69 birds was removed, of which 47 were collected on July 4, the day before the census. The total numbers of birds collected during the periods between the census days are as follows: June 14 to 20, 156; June 22 to 27, 114; June 29 to July 4, 123; and July 6 to 10, 116. The first figure (156) represents the number required to reduce the population to the 20 per cent level while the remaining figures (114, 123, and 116) indicate the weekly removal rate to keep the population at that level.

SUMMARY

The population of territorial male birds in a 40-acre tract of spruce-fir forest in northern Maine was 148 pairs during the 1949 season, June 6–14, and 154 pairs during the 1950 season, June 6–13. An attempt was made to remove, or to reduce drastically, the bird population with the use of fire-arms. By this means the population was reduced to 21 per cent by June 21, 1950, and held at this level by continuous collection of new arrivals until July 11, 1950. A total of 528 adult birds was collected, 108 more than during the previous year.

A rapid influx of new males and the establishment of the same territories as used by their predecessors were very much in evidence. Apparently the carrying capacity of this Spruce-Fir forest was not sufficient to meet the combined requirements of all the males. This, therefore, resulted in a surplus population of birds unable to establish territories and to mate. This surplus acted as a reserve supply to fill in or replenish gaps when an area was depleted. The ratio of males collected to the number of territorial males on the area prior to collecting was quite different for each species.

The number of adult females collected was much less than the number of males. This is due in part to the inconspicuousness of the breeding female. Forty-four more females were taken during the 1950 season than in the 1949 study. The increase can be partially accounted for by the presence of an additional collector and by the fact that nesting activities were considerably advanced due to the warm period which occurred during the latter part of May. The females were thus more attentive to nesting activities and stayed in the area longer; consequently, they were subject to collecting pressure longer in the 1950 season than in 1949.

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SOUND PRODUCTION IN PASSERINE BIRDS

BY MILDRED MISKIMEN

IN spite of widespread popular and scientific interest in the singing of birds there is some difference of opinion with regard to the actual functioning of the vocal organ, the syrinx. The British writers, Thomson (1923) and Parker and Haswell (1940) regard the semilunar membrane as the actual sound-producing organ. Miller (1947) by experimental methods determined that in owls and some other birds sound is produced by "the vibrations—set up in loose membranes between bronchial and tracheal rings" but he ascribes the sound produced by singing birds to vibrations of the semilunar membrane. Stresemann (1934), however, asserts that in passerine birds the vibrations produced by air passing over the tympaniform membranes produce the sounds heard in song, and that in song birds the intrinsic syringeal muscles regulate the tensions of these membranes. Cole (1945) in his writing accepts the opinion of Stresemann. The purpose of this study was first, to determine by experiment the way in which sound is produced in passerine birds, and second, to determine whether the structure of the syrinx correlates in any way with the quality of the song.

ACKNOWLEDGMENTS

This study was made at the Ohio State University under the direction of Dr. Loren S. Putnam, to whom I am deeply grateful for his kindly guidance and encouragement in every phase of the work. Most of the specimens were collected by Mr. Eugene Knoder in the immediate vicinity of Columbus, Ohio, but the Starlings used in the studies on anaesthetized birds were from the state of New York and were given by Mr. W. D. Fitzwater, of the United States Fish and Wildlife Service. The illustrations are by Mr. Robert Albertin and are drawn from the Eastern Crow, *Corvus brachyrhynchos*. I wish to thank these and others in the Department of Zoology and Entomology of the Ohio State University who have helped me in many ways.

THE SOURCE OF SOUND

The semilunar membrane is located inside the trachea on the cephalad edge of the pessulus, marking the beginnings of the bronchial tubes. If air passing over it produces sound after the manner of air passing across the reed of a clarinet, then sound must be produced while air is entering the bird's lungs, which is the relaxed or "passive phase" of respiration in birds. In mammals, as we know, voice is produced during exhalation, which in them is the "passive phase." Thomson and other writers have stated, however, that voice in birds is produced during the "active phase" of respiration, that is, while the muscles of the thorax are forcing air from the lungs. These were points to be tested experimentally.

A common rubber ear syringe was used in this part of the work. The syringe was applied to the severed end of the trachea of an anaesthetized English Sparrow, *Passer domesticus*, and air was forced through the respiratory tubes in alternating directions by compressing and releasing the bulb.

No sound was produced by forcing air into the trachea, but when the bulb was released and air drawn back into the bulb the bronchial tubes partly collapsed and a chirping noise was made. The internal tympaniform membrane just above the insertions of the bronchidesmus membrane on the first bronchial half-rings vibrated freely and rapidly in the inter-bronchial space. These vibrations could easily be seen by placing the bird on the stage of a binocular microscope during the operation. Normally, tension seems to be maintained by the rigidity of the bronchial half-rings, while the relaxation of the membranes due to the difference in internal and external air pressure permitted the vibrations. This agrees with the observations of Miller in his study of owls (1947).

The next step was to force air out through the syrinx by pressure from within. A small hole was made in the abdominal air-sac at the end of the sternum, into which the tip of a medicine dropper was

inserted tightly and the rubber syringe fitted snugly into the other end of the dropper. Air could be forced into the air-sac and out through the trachea, producing sound like that produced by drawing air out from the tracheal end. Considerable pressure had to be applied before the sudden, loud chirp was heard.

Drawing air into the air-sac by releasing the bulb produced no sound. It was thought that the intervening air passages through the lungs might interfere with the free passage of air under sufficient pressure and that suction applied directly to the bronchial tubes might produce some sound. As the bronchial tubes of the sparrow are so fine that no effective way to do this could be devised, a Ring-necked Pheasant, *Phasianus colchicus*, was used for this part of the experiment, since its bronchii are larger. Sound was produced when air was drawn outward through the trachea, but not when drawn inward through tubes attached to the bronchii.

The trachea of a Starling, *Sturnus vulgaris*, was cut off close to the syrinx. By inserting a slender blade the semilunar membrane was entirely removed. After this, air was passed through the syrinx as before, and sounds were produced as usual. There was no noticeable modification of sound quality after the removal of the membrane.

From these experiments it seems: 1) that sound is produced, at least in the forms examined, during the active, or exhalant, phase of respiration; 2) that the semilunar membrane has no important function, if any, in the production of sound; and 3) that sound originates in vibrations of the tympaniform membranes set up by air currents from the lungs.

FUNCTION OF SYRINGEAL MUSCLES IN PRODUCTION OF SOUND

Starlings were chosen for this study because they have the full set of seven pairs of syringeal muscles and a wide variety of calls. The syringeal muscle system of Starlings, and of other birds having seven pairs of syringeal muscles (Table 1), is similar to that of the European Raven, *Corvus corax sinuatus*, as described by Owen (1866) and by Shufeldt (1890). Stresemann (1934) gives an accurate, detailed description of the action of the different muscles. The drawings shown in Figures 2 and 3, made from the Eastern Crow, *Corvus brachyrhynchos*, indicate the locations of these muscles.

Since the syrinx lies dorsal to the heart it is difficult to study it in a live, anaesthetized bird. In order to study its structures in living tissues the bird was given ether and dissection begun when it was in the deep breathing state. After the sternum and furculum were removed the heart was found still beating. By quickly removing the heart

the syrinx was reached while life remained in the muscles. The electrodes of a 22-volt, dry-cell battery were applied successively to each pair of syringeal muscles. The current contracted the muscles and produced rigor mortis in the contracted state. After each pair of muscles was immobilized air was again passed through the syrinx by drawing it through the trachea with the syringe. Changes in the position of the intermediary bars (Fig. 1) with respect to each other, resultant effects upon the syringeal membranes, and changes in sound were noted.

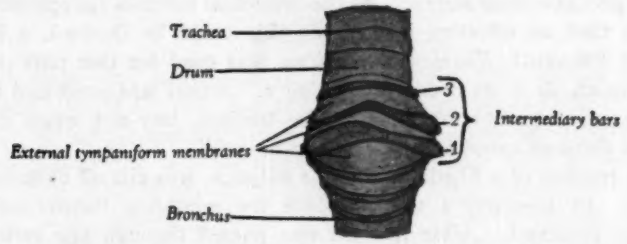

FIGURE 1. Syringeal cartilages of the Crow, right side.

Contraction of *Mm. broncho-trachealis anticus* and *posticus* draws the first intermediary bar cephalad and rotates the cephalad edge of the bar inward. This brings the external and internal tympaniform membranes close together. The current of air through the syrinx then sets up vibrations in the membranes on both sides of the first intermediary bar as well as in the internal tympaniform membrane. During the vibrations the external and internal membranes come in contact, as can be seen through the transparent walls. This action is marked by a noticeable change in tone. A rise in pitch is noted after contraction of *M. broncho-trachealis anticus*, drawing the second intermediary bar cephalad. Contraction of *M. broncho-trachealis brevis* produces an internal fold of membrane cephalad to the third intermediary bar and a slight change in tone. No change in tone can be detected when contraction of *M. bronchialis posticus* draws the second intermediary bar slightly ventral.

These observations, with respect to the changes in tone, are of necessity inaccurate as compared to sounds produced by a living bird, but they give a general idea of the function of the muscles involved.

During these manipulations the bronchidesmus membrane was drawn gradually closer to the intermediary bars. When finally all the muscles were contracted, its edge fitted along the base of the pessulus and the apex of the bronchii, shutting the internal tympani-

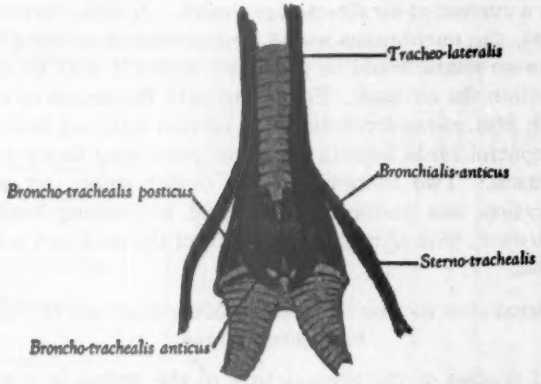

FIGURE 2. Syringeal Muscles of the Crow, ventral view.

form membrane in a tight box between the bronchidesmus membrane and the dorso-syringeal membrane.

Mm. tracheo-lateralis and *sterno-trachealis* work in opposition, the former being the tensor and the latter the releaser of tension of the syringeal membranes. When the trachea and syrinx are in their relaxed positions, sound can be produced artifically only by applying great pressure within the air-sacs. When *Mm. sterno-trachealis* are contracted (or when the trachea is cut) the syrinx moves caudad, the internal tympaniform membrane becomes relaxed and vibrates

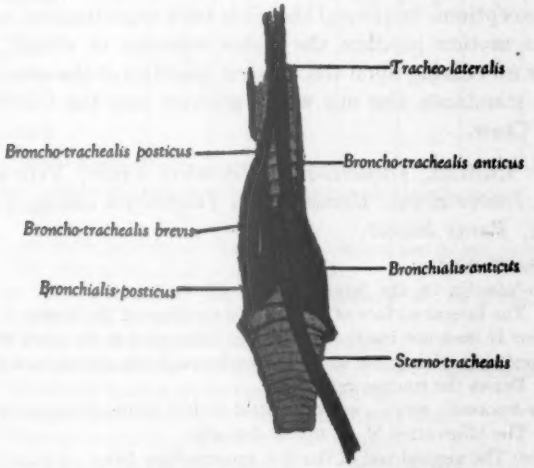

FIGURE 3. Syringeal Muscles of the Crow, right side.

steadily in a current of air directed cephalad. If *Mm. sterno-trachealis* were absent, the membranes would remain taut in a living bird, and presumably no sound would be produced, unless it were by very great pressure within the air-sacs. Four Cardinals, *Richmondena cardinalis*, from which *Mm. sterno-trachealis* were excised were not heard to sing, although control birds kept in the same pens sang freely during the singing season. Two domestic cocks, *Gallus gallus*, on which the same operation was performed succeeded in crowing loudly a few weeks afterward, with unusual contortions of the neck and a somewhat altered tone.

COMPARISON OF THE SYRINGEAL MUSCULATURE OF SOME PASSERINE BIRDS

Detailed studies of the musculature of the syrinx in a number of passerine birds show that not only do many birds lack certain of the seven pairs of syringeal muscles, but that the attachments of the muscles vary widely. The birds I have been able to study are arranged here (Table 1) in five groups according to the number of syringeal muscles possessed by each, and within each group they are arranged according to the attachments of the muscles. Those with attachments allowing the greatest freedom of motion are at the top of the list, and those having only more restricted movement are farther down. A detailed description of one bird in each group is given, which may be considered typical of that group, with deviations indicated in the text. A study of these descriptions will show that while there are exceptions, in general the birds with more muscles and greater freedom of motion produce the wider varieties of sound. This, of course, has no bearing upon the musical qualities of the song as judged by human standards, else one would scarcely rate the Cardinal so far below the Crow.

GROUP A: Catbird, *Dumetella carolinensis;* Crow; Yellow-breasted Chat, *Icteria virens;* House Wren, *Troglodytes aëdon;* Tufted Titmouse, *Parus bicolor.*

Muscles in the Catbird:

1. *Tracheo-lateralis*, on the lateral surface of the trachea.
   Origin: The lateral surface of the thyroid cartilage of the larynx.
   Insertion: It does not insert directly, but bifurcates at the level of the second tracheal ring, giving rise to *Mm. broncho-trachealis anticus* and *posticus*.
   Action: Draws the trachea cephalad.
2. *Broncho-trachealis anticus*, on the ventral surface of the syrinx, external.
   Origin: The bifurcation of *M. tracheo-lateralis*.
   Insertion: The ventral end of the first intermediary bar.
   Action: Draws the first intermediary bar cephalad.

TABLE 1

COMPARISON OF SYRINGEAL MUSCLES PRESENT IN DIFFERENT SPECIES

	Tracheo-lateralis	*Broncho-trachealis anticus*	*Broncho-trachealis posticus*	*Broncho-trachealis brevis*	*Sterno-trachealis*	*Bron-chialis anticus*	*Bron-chialis posticus*	*Total pairs muscles*
GROUP A								
Catbird	x*	x	x	x	x	x	x	7
Starling	x	x	x	x	x	x	x	7
Crow	x	x	x	x	x	x	x	7
Yellow-breasted Chat	x	x	x	x	x	x	x	7
House Wren	x	x	x	x	x	x	x	7
Tufted Titmouse	x	x	x	x	x	x	x	7
GROUP B								
Song Sparrow	x	x	x	x	x	x		6
Horned Lark	x	x	x	x	x	x		6
Cardinal	x	x	x	x	x	x		6
Vesper Sparrow	x	x	x	x	x	x		6
Meadowlark	x	x	x	x	x	x		6
Bobolink	x	x	x	x	x	x		6
Red-eyed Vireo	x	x	x		x	x	x	6
Scarlet Tanager	x	x	x		x	x	x	6
White-breasted Nuthatch	x	x	x		x	x		5
GROUP C								
Cowbird		x	x	x	x	x	x	6
Ruby-crowned Kinglet		x	x	x	x	x		5
Golden-crowned Kinglet		x	x	x	x	x		5
Dickcissel		x	x	x	x	x		5
Goldfinch		x	x	x	x	x		5
Yellow Warbler		x	x	x	x	x		5
Red-wing		x	x	x	x	x		5
Cedar Waxwing		x	x	x	x	x		5
Robin		x	x	x	x	x		5
Bronzed Grackle		x	x	x	x	x		5
GROUP D								
Chipping Sparrow	x	x	x		x	x		5
Barn Swallow	x	x	x		x	x		5
Grasshopper Sparrow	x	x	x		x			4
English Sparrow		x	x		x	x		4
GROUP E								
Alder Flycatcher		?			x	?		3
Wood Pewee		?			x	?		3

* x in this space indicates the presence of the muscle, a blank indicates its absence, and ? indicates doubt as to homology.

3. *Broncho-trachealis posticus*, on the dorsal surface of the syrinx, external.
   Origin: The bifurcation of *M. tracheo-lateralis*.
   Insertion: The dorsal end of the first intermediary bar, by a tendon over the end of the second intermediary bar.
   Action: Draws the first intermediary bar cephalad.
4. *Broncho-trachealis brevis*, on the dorsal surface of the syrinx, internal.
   Origin: The dorsal surface of the first tracheal ring.
   Insertion: The dorsal end of the second intermediary bar.
   Action: Draws the second intermediary bar cephalad.
5. *Sterno-trachealis*, extending ventro-laterally from the syrinx.
   Origin: The lateral cranial process of the sternum.

Insertion: The lateral surface of the first tracheal ring.
Action: Draws the trachea caudad.

6. *Bronchialis anticus*, on the ventral surface of the syrinx, internal.
Origin: The ventral surface of the first tracheal ring.
Insertion: The ventral end of the second intermediary bar.
Action: Draws the second intermediary bar cephalad.
7. *Bronchialis posticus*, on the lateral surface of the syrinx.
Origin: The latero-ventral surface of the first tracheal ring.
Insertion: The dorsal end of the second intermediary bar.
Action: Draws the second intermediary bar ventral.

Each bird of this group possesses seven pairs of syringeal muscles but only in the Catbird, Starling, and Crow do we find the first two intermediary bars with muscle attachments at each end. This arrangement allows the first bar to rotate on its long axis and permits delicate adjustments of tension in the tympaniform membranes. In the Chat the second bar has no dorsal muscle attachments (*Mm. broncho-trachealis posticus* and *brevis* attach to the third bar), and the ventral muscle instead of being at the end of the bar attaches along it for about one-fourth of its length. For this reason the syrinx of the Chat is not quite so mobile as those of the first three birds. There is still less motion in the syrinx of the House Wren; the third intermediary bar has no muscular attachments, and the first and second bars have their ventral muscles attached along half the length of the bars at the cephalad edges. Muscles so attached do not rotate the first intermediary bar on its long axis, nor do they give the delicate precision of adjustments of tension found in the Catbird, Starling, and Crow. In the Titmouse the first intermediary bar has no muscle at the dorsal end, *M. broncho-trachealis posticus* being attached to the third bar instead of the first. The first bar is, therefore, less mobile than that of other birds of this group.

GROUP B: Song Sparrow, *Melospiza melodia;* Prairie Horned Lark, *Eremophila alpestris praticola;* Cardinal; Vesper Sparrow, *Pooecetes gramineus;* Meadowlark, *Sturnella magna;* Bobolink, *Dolichonyx oryzivorus;* Red-eyed Vireo, *Vireo olivaceus;* Scarlet Tanager, *Piranga olivacea;* White-breasted Nuthatch, *Sitta carolinensis.*

Muscles in the Song Sparrow:

1. *Tracheo-lateralis*, on the lateral surface of the trachea.
Origin: The lateral surface of the thyroid cartilage of the larynx.
Insertion: It does not insert directly, but bifurcates at the level of the fifth tracheal ring, giving rise to *Mm. broncho-trachealis anticus* and *posticus.*
Action: Draws the trachea cephalad.
2. *Broncho-trachealis anticus*, on the ventral surface of the syrinx, external.
Origin: The bifurcation of *M. tracheo-lateralis.*

Insertion: The ventral end of the first intermediary bar.
Action: Draws the first intermediary bar cephalad.

3. *Broncho-trachealis posticus*, on the dorsal surface of the syrinx, external.
Origin: The bifurcation of *M. tracheo-lateralis*.
Insertion: The dorsal end of the first intermediary bar.
Action: Draws the first intermediary bar cephalad.
4. *Broncho-trachealis brevis*, on the dorsal surface of the syrinx, internal.
Origin: The lateral surface of the syringeal drum.
Insertion: The dorsal end of the second intermediary bar.
Action: Draws the second intermediary bar cephalad.
5. *Sterno-trachealis*, extending ventro-laterally from the syrinx.
Origin: The lateral cranial process of the sternum.
Insertion: The cephalad edge of the lateral surface of the syringeal drum.
Action: Draws the trachea caudad.
6. *Bronchialis anticus*, on the ventral surface of the syrinx, internal.
Origin: The ventral cephalad edge of the syringeal drum.
Insertion: The ventral half of the second intermediary bar.
Action: Draws the second intermediary bar cephalad.
7. *Bronchialis posticus*, is not present.

Birds in this group lack either *M. broncho-trachealis brevis* or *M. bronchialis posticus*, or both. In birds having both, we usually find the muscles attached to the ends of the second intermediary bar, giving it motion in two directions, as in the Catbird. In these birds the second bar has but one dorsal muscle attachment, and in some cases it shares that with the third bar, the two being bound together at the dorsal ends. In the Tanager *M. broncho-trachealis posticus* attaches to the dorsal end of the second intermediary bar, leaving the first bar without a dorsal attachment. In the Nuthatch *Mm. broncho-trachealis anticus* and *posticus* attach respectively to the second and third intermediary bars, leaving the first bar without attachment and the second bar with only the ventral muscle.

GROUP C: Cowbird, *Molothrus ater;* Golden-crowned Kinglet, *Regulus satrapa;* Ruby-crowned Kinglet, *R. calendula;* Dickcissel, *Spiza americana;* Goldfinch, *Spinus tristis;* Yellow Warbler, *Dendroica aestiva;* Redwing, *Agelaius phoeniceus;* Cedar Waxwing, *Bombycilla cedrorum;* Robin, *Turdus migratorius;* and Bronzed Grackle, *Quiscalus quiscula.*

Muscles in the Cowbird:

1. *Tracheo-lateralis* is not present.
2. *Broncho-trachealis anticus*, on the ventral surface of the syrinx, external.
Origin: The lateral surface of the sixth tracheal ring.
Insertion: The ventral end of the first intermediary bar.
Action: Draws the first intermediary bar cephalad.
3. *Broncho-trachealis posticus*, on the dorsal surface of the syrinx, external.
Origin: The lateral surface of the sixth tracheal ring.

Insertion: The dorsal end of the first intermediary bar.
Action: Draws the first intermediary bar cephalad.

4. *Broncho-trachealis brevis*, on the dorsal surface of the syrinx, external.
Origin: The dorsal surface of the fourth tracheal ring.
Insertion: The dorsal end of the second intermediary bar.
Action: Draws the second intermediary bar cephalad.
5. *Sterno-trachealis*, extending latero-ventrally from the syrinx.
Origin: The lateral cranial process of the sternum.
Insertion: The lateral surface of the first tracheal ring.
Action: Draws the trachea caudad.
6. *Bronchialis anticus*, on the ventral surface of the syrinx, internal.
Origin: The ventral cephalad edge of the syringeal drum.
Insertion: The ventral half of the second intermediary bar.
Action: Draws the second intermediary bar cephalad.
7. *Bronchialis posticus*, on the lateral surface of the syrinx.
Origin: The ventral cephalad edge of the syringeal drum.
Insertion: The dorsal end of the second intermediary bar.
Action: Draws the second intermediary bar ventral.

These birds lack *M. tracheo-lateralis*, and all but the Cowbird also lack either *M. broncho-trachealis brevis*, *M. bronchialis posticus*, or both. Only the Kinglets, the Dickcissel, and the Goldfinch have the muscles attached to the ends of the intermediary bars; the others have broad attachments of *M. bronchialis anticus* along the second intermediary bar, and the Robin and the Grackle also have broad attachments of *M. broncho-trachealis anticus* along the first bar. This suggests that in this group the Kinglets, the Dickcissel, and the Goldfinch have the more refined muscular control of the intermediary bars and the intervening membranes, while the Robin and the Grackle have the least detailed control and would be expected to have a narrower range of varied notes. The Black and White Warbler, *Mniotilta varia*, and the American Redstart, *Setophaga ruticilla*, have this musculature similar to that in the Yellow Warbler.

GROUP D: Chipping Sparrow, *Spizella passerina;* Barn Swallow, *Hirundo rustica;* Grasshopper Sparrow, *Ammodramus savannarum;* and English Sparrow, *Passer domesticus*.

Muscles in the Chipping Sparrow:

1. *Tracheo-lateralis*, on the lateral surface of the trachea.
Origin: The lateral surface of the thyroid cartilage of the larynx.
Insertion: It does not insert directly but bifurcates at the level of the third tracheal ring, giving rise to *Mm. broncho-trachealis anticus* and *posticus*.
Action: Draws the trachea cephalad.
2. *Broncho-trachealis anticus*, on the ventral surface of the syrinx, external.
Origin: The bifurcation of *M. tracheo-lateralis*.
Insertion: The ventral half of the first intermediary bar.
Action: Draws the first intermediary bar cephalad.

3. *Broncho-trachealis posticus*, on the dorsal surface of the syrinx, external.
   Origin: The bifurcation of *M. tracheo-lateralis*.
   Insertion: The first and second intermediary bars, the two united at their dorsal ends.
   Action: Draws the first and second intermediary bars cephalad.
4. *Broncho-trachealis brevis* is not present.
5. *Sterno-trachealis*, extending ventro-laterally from the syrinx.
   Origin: The lateral cranial process of the sternum.
   Insertion: On *M. tracheo-lateralis*, near the point of its bifurcation.
   Action: Draws the trachea caudad.
6. *Bronchialis anticus*, on the ventral surface of the syrinx, internal.
   Origin: The ventral cephalad edge of the syringeal drum.
   Insertion: The ventral half of the second intermediary bar.
   Action: Draws the second intermediary bar cephalad.
7. *Bronchialis posticus* is not present.

The birds in this group might have been included in Groups B and C, considering the numbers of muscles each possesses, but they are placed separately in order to illustrate the ineffectiveness of muscles whose attachments preclude dexterity of motion in the syrinx. In the Swallow the cartilages are small and very close together. The first intermediary bar is wide and flat, and the expanse of external tympaniform membrane on each side is small. The third intermediary bar has a hammer-like protrusion on the dorsal end which crosses the ends of the other two bars. There is no muscle attachment to the dorsal end of the first intermediary bar. Due to this combination there can be little movement of the cartilages and membranes of the syrinx. The other three birds in the group have very wide attachments of the ventral muscles to the intermediary bars, and in the English Sparrow the dorsal ends of the first two bars are fastened firmly together by a ligament, allowing them no independent motion.

GROUP E: Alder Flycatcher, *Empidonax traillii*, and Eastern Wood Pewee, *Contopus virens*.

In these and other specimens of the Tyrannidae were found syringes differing from both the typical non-passerine syrinx without intrinsic muscles and the syrinx of the Passeres with paired longitudinal muscles. *M. sterno-trachealis* inserts high on the trachea, at about the thirteenth ring, after the manner of the non-passerines, but *M. tracheo-lateralis*, so prominent in non-passerines, is absent. One continuous, broad, flat muscle lies on the ventral surface of the trachea from about the thirteenth ring to the cephalad edge of the drum, and a pair of muscles originating on the mid-ventral line of the drum extends transversely to the dorsal ends of the second intermediary bars. Contractions of these muscles could alter the quality of sound but little.

SUMMARY

Experiments on dissected, anaesthetized birds show that sound is produced by air currents passing through the respiratory tubes in the caudo-cephalad direction and setting up vibrations in the syringeal membranes. Tension on these membranes is regulated primarily by the opposing action of *Mm. sterno-trachealis* and *tracheo-lateralis*, and secondarily by the action of the intrinsic syringeal muscles. Both pitch and quality of sound depend upon the tension control of the syringeal membranes by the intrinsic syringeal muscles.

The arrangement of the birds studied, in the order of the number of syringeal muscles possessed by each species, shows that in general the birds possessing more muscles are able to produce a wider variety of notes than those having fewer muscles, providing that the muscles are attached to the syringeal cartilages in such a way that these cartilages may move freely, regulating with precision the tension on the vibrating syringeal membranes. There is, therefore, direct correlation between the degree of development of the syrinx, with respect to muscles and attachments, and the quality (variety of notes) of the song.

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Department of Zoology and Entomology, Ohio State University, Columbus, Ohio, August 16, 1950.

THE HAWAIIAN STILT

BY CHARLES W. SCHWARTZ AND ELIZABETH REEDER SCHWARTZ

These photographs of the graceful Hawaiian Stilt, *Himantopus himantopus knudseni*, constitute a pictorial record of one of the world's vanishing birds. In 1944, Mr. George Munro of Honolulu (Birds of Hawaii, Tongg Publ. Co., Honolulu) estimated only 200 stilts were left in the Hawaiian Islands. We believe, that in spite of its dwindling habitat, the closed hunting season on the Islands during the recent war and its continuation for stilts permitted the population to increase to approximately 1,000 birds by 1946–1947 (Schwartz and Schwartz, The Game Birds in Hawaii, Bd. Agric. and For., Honolulu, 1949).

The Hawaiian Stilt maintains its largest numbers on the island of Oahu where its best habitat exists. Smaller flocks occur on Niihau, Kauai, and Maui islands, and possibly some may use the island of Molokai. Our limited observations did not ascertain the permanency of the stilt population on each island, but reports by local inhabitants indicate possible movements between islands. We have observed considerable daily shifting of the flocks between different locales on each island.

Stilts frequent the coastal mud flats and the fresh and brackish marshy areas and shallows of reservoirs, lakes, and ponds. The vegetative types most commonly associated with this habitat are great bulrush, *Scirpus validus*, american saltwort, *Batis maritinia*, and various grasses. In spite of the upward trend of the stilt population, the future of this species is not bright since the habitat it prefers is rapidly disappearing due to the reclamation of such areas for civic and military purposes. Illegal kill still constitutes a limiting factor.

Two adult Hawaiian Stilts were confiscated on April 6, 1947, from a hunter. They measured as follows:

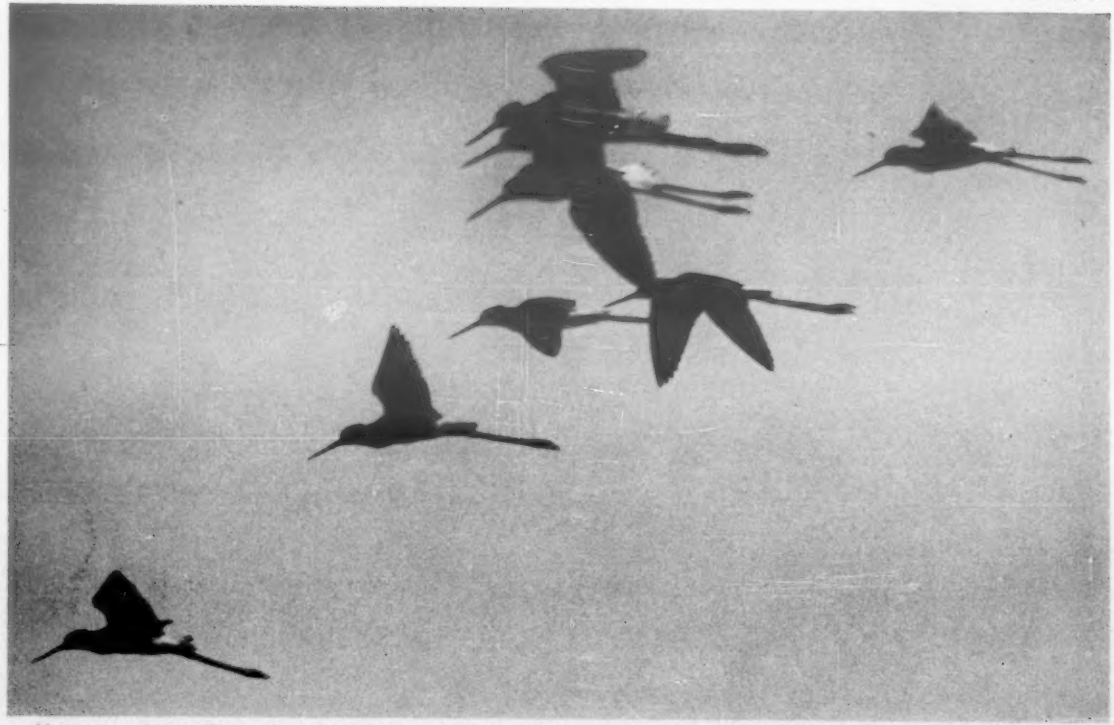
	Male	*Female*
Total length	396 mm.	395 mm.
Culmen	77	77
Extent of wing	680	690
Closed wing	216	220
Tail	87	80
Length of longest toe	42	42

Both were lightly infested with mallophaga and each contained two cestodes, in their small intestines. These cestodes were tentatively identified by Mr. Ernest Ediger of the U. S. Fish and Wildlife Service as being *Diplophallus* (*polymorphus*) which has also been recorded from

specimens of *H. himantopus* (locale of specimen unknown), and *H. h. mexicanus*, from North America. The crops of both birds were empty but the remains in the gizzards consisted of snail shells, small fish scales, mud, and particles of basalt and feldspar.

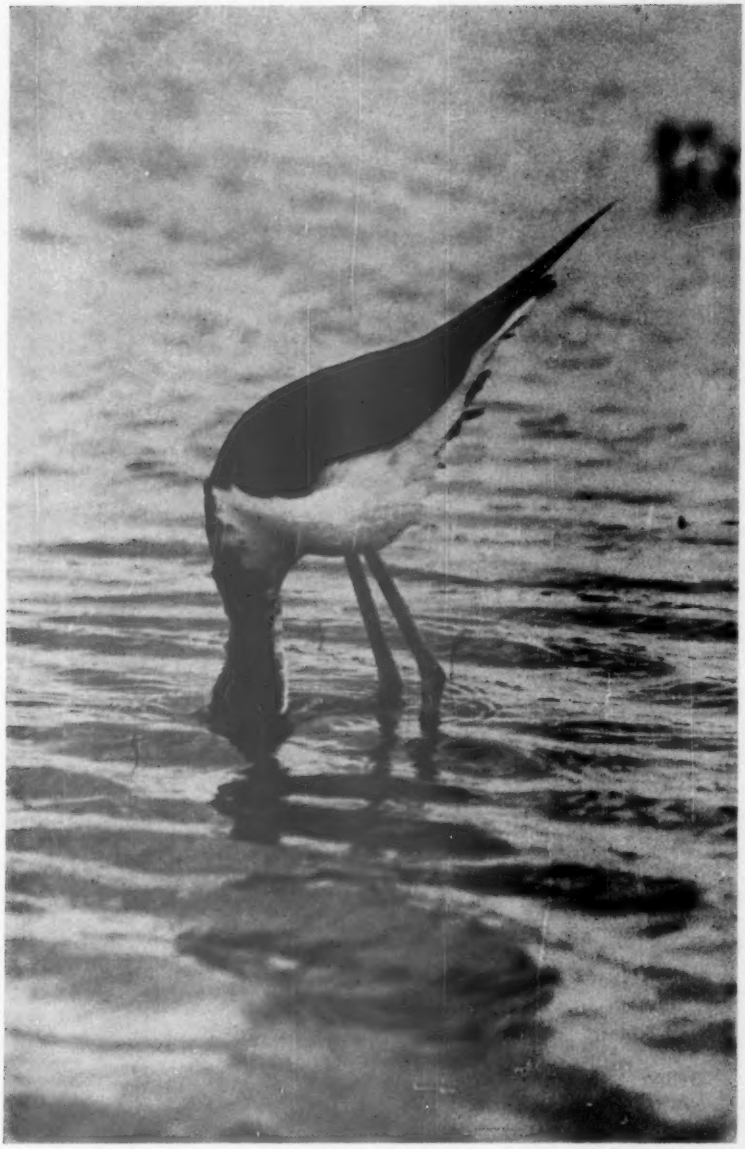
We do not know when the Hawaiian Stilt breeds, but in the first week of April, 1947, we observed what appeared to be three family groups of adults and young. The young were distinguished from the adults by a slightly smaller size, their calls, and actions. At this same time, one other stilt exhibited behavior indicating a nest near by, but subsequent search failed to reveal its presence. The two confiscated adult stilts mentioned above were non-breeding, although the oviduct of the female was enlarged and appeared typical of a post-breeding condition.

Conservation Commission, Jefferson City, Missouri.



HAWAIIAN STILT *Himantopus himantopus knudseni*, IN FLIGHT. APRIL, 1947. KUAPA POND, OAHU, HAWAII.

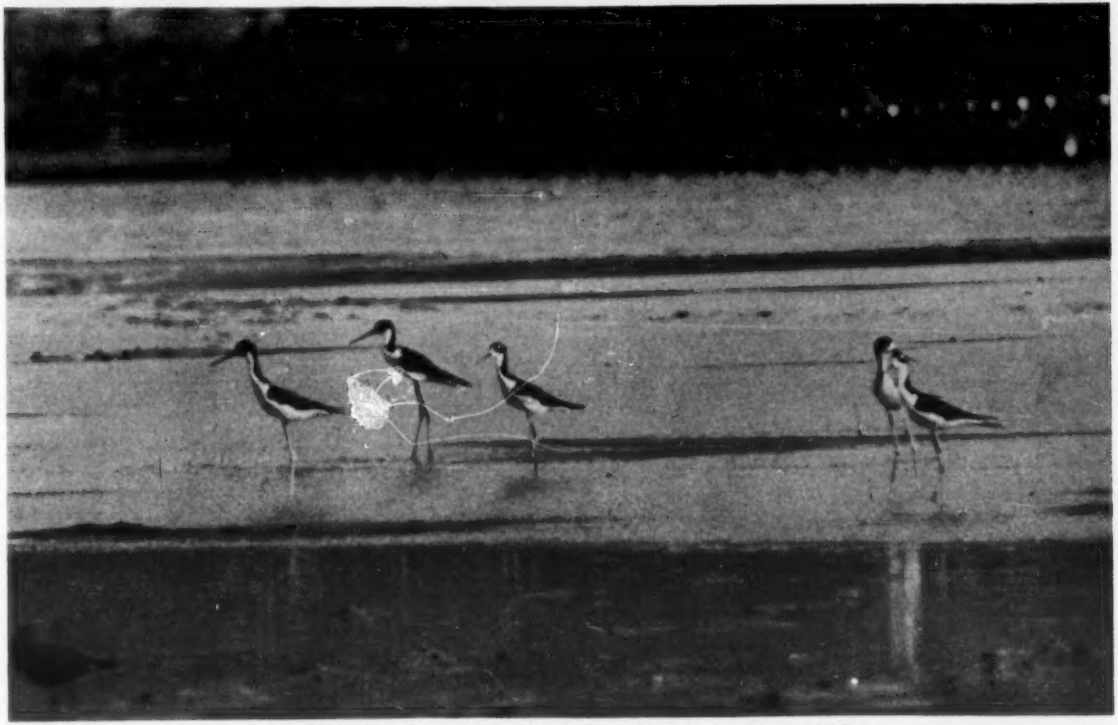
PART OF A FLOCK OF 68 HAWAIIAN STILTS IDLING IN THE SHALLOWS OF KUAPA POND, OAHU, HAWAII. APRIL, 1947. TO THE LEFT, THREE WANDERING TATTLERS, *Heteroscelus incanus*, ARE RESTING.



HAWAIIAN STILT PROBING IN THE MUD BOTTOM OF KUAPA POND, OAHU, HAWAII. APRIL, 1947.

HAWAIIAN STILTS LANDING. KUAPA POND, OAHU, HAWAII. APRIL, 1947.

HAWAIIAN STILT. KUAPA POND, OAHU, HAWAII. APRIL, 1947.



HAWAIIAN STILTS. KUAPA POND, OAHU, HAWAII. APRIL, 1947.

GENERAL NOTES

A Florida Specimen of Sennett's Nighthawk, *Chordeiles minor sennetti*.—While examining a number of Nighthawks in the University of Michigan Museum of Zoology, I recently handled a considerable series from Florida. As would be expected, these are mostly referable to the race *chapmani*, with a few migrant examples of *minor*. However, there is one adult male, taken at Clay Springs, Orange County, by Wm. J. E. Bross on April 21, 1896, which I have identified as *C. m. sennetti*. The wing of this bird measures 201 millimeters and is too large for *chapmani*. The range in wing measurements of a series of 14 male *chapmani* from Florida is given by Oberholser (U. S. Nat. Mus. Bull., 86: 75, 1914) as 178–192 millimeters with a mean of 184.1. In plumage the present specimen agrees with a good series of *sennetti*, being too pale for either eastern subspecies.

A check of routine sources (Howell, 'Florida Bird Life,' 1932; 'Zoological Record,' 1930–1945) fails to reveal any other Florida record of this Nighthawk; McAtee, Burleigh, Lowery, and Stoddard (Wilson Bull., 56: 152–160, 1944) do not list it as a migrant east of Louisiana.—ROBERT M. MENGEL, *University of Michigan Museum of Zoology, Ann Arbor, Michigan.*

Aerial Feeding on Insects by Ruby-throated Hummingbird, *Archilochus colubris*.—During the early evening of August 19, 1950, at Pottageville, Ontario, a Ruby-throated Hummingbird was first observed in direct flight toward a flower garden where it was accustomed to feed at various times during the day. Suddenly it wheeled and began a series of gyrations. The tangled course of its aerial maneuvers was encompassed in a restricted space estimated at seven or eight feet in diameter. The performance lasted for nearly a minute. The angle of the sun made it possible to perceive numerous tiny insects in the air. Because of the speed of action one could not see the insects actually grasped by the bird but such was apparent. I have seen no better display of aerial feeding by goatsuckers or swifts.

A partial survey of the literature reveals that this habit has been observed, but rarely. Roberts (The Birds of Minnesota, Univ. Minn. Press, 1: 654, 1932) records a similar observation as does Wilson (American Ornithology, Brewer Edition, 1854: 118–119).—L. L. SNYDER, *Royal Ontario Museum of Zoology, Toronto, Canada.*

A Western Record of the Quetzal, *Pharomachrus mocinno mocinno*, and Chachalaca, *Penelopina nigra*, in Mexico.—During recent biological investigations in the Isthmus of Tehuantepec, Mexico, Mr. Thomas MacDougall was successful in obtaining a specimen of the Quetzal. The Quetzal occurs principally in Central America, but has been known from mountainous areas of Chiapas, Mexico. MacDougall's record indicates that this species occurs still farther westward and northward into the Sierra Madre of eastern Oaxaca.

The Quetzal was obtained in the cloud forest near the divide on the Atlantic slope of the Sierra Madre, at about 5000 feet elevation and approximately 12 miles east of La Gloria and toward Cerro Azul (= Cerro Prieto), Oaxaca, on March 25, 1949. La Gloria is 18 miles north of Niltepec and about 50 miles northeast of Tehuantepec. Cerro Azul or Cerro Prieto is the local name for the highest group of peaks in the Sierra Madre. Where the Quetzal was taken there were many epiphytic plants, including several species of cacti and bromeliads, together with tree ferns, several kinds of undergrowth palms, and large-acorned oaks, and to a lesser extent white pines and red gum. The trees were heavily covered with mosses. The specimen obtained was one of a pair, apparently nesting, with the female remaining in the area

after the male had been collected. However, the Quetzal is not common and is restricted to this particular area, for Mr. MacDougall found no natives that had previously seen such a bird. It should also be pointed out that no natives lived in or very near this cloud forest nor had any even penetrated it. Natives who cross the Sierra Madre at elevations lower than where the Quetzal was taken are not familiar with the bird, although they most certainly would be aware of such a conspicuous species if it occurred there. Two of the native boys, who were with MacDougall when the specimen was collected, returned to this particular cloud forest in June, 1950, penetrated it farther, and heard several Quetzals calling and observed two individuals.

Field investigations by MacDougall in Chiapas and Oaxaca would indicate a probable distribution of the cloud forest and Quetzal in these two states about as follows. There is a continuous or nearly continuous cloud forest along the Sierra Madre of coastal Chiapas northwestward to the vicinity of Tonalá. Quetzals have recently been obtained by the inhabitants from the Sierra Madre northwest of Tapachula, and particularly in the vicinity of Mapastepec. Farther inland, cloud forest is encountered in the Montebello area near Comitán and the Guatemalan border, and formerly Quetzals were collected for commercial purposes in this area. Cloud forests continue northwestward near Ciudad de Las Casas and to the north of Tuxtla Gutierrez and thence westward into the Sierra Madre of Oaxaca. Between Tonalá, Chiapas, and extreme southeastern Oaxaca, the Sierra Madre decreases in elevation below the level of the cloud forest, and suitable habitat for the Quetzal disappears. Thus, it appears that the distributional pattern southeastward from Oaxaca would be through the interior of Chiapas and not coastally. A report of a Quetzal, shot in the cloud forest at El Fénix, Chiapas, near the Oaxaca boundary, would lend credence to this distributional pattern.

Although cloud forest is present west of the Isthmus of Tehuantepec in Oaxaca, field work by many groups and reports from natives fail to indicate that the range of the Quetzal extends west of the Isthmus. It is highly probable that the present record represents very nearly the extreme northwestern limit of the range of the species.

Of more common occurrence in the rain forest of the Isthmus of Tehuantepec is a Chachalaca, achiote, or "pasha," *Penelopina nigra* Fraser, yet its occurrence in Mexico beyond Chiapas seems unrecorded. Although MacDougall saved no specimens of *Penelopina*, a photograph of a recently killed female readily identifies the bird. This species was common in the highlands near Rio Grande, 15 miles north of Niltepec, and along the trails between this town and La Gloria, at elevations up to nearly 4500 feet. Eggs and young birds are sometimes obtained by the natives. On some occasions, these birds come down the slopes to about 1500 feet elevation. The fact that nearly all the inhabitants know this Chachalaca indicates it is fairly common in the Sierra Madre of the eastern portion of the Isthmus.

Mr. MacDougall is to be commended for his detailed observations in this critical and interesting region. Mr. Emmet R. Blake of the Chicago Natural History Museum has kindly checked the skin and photograph with me.—DONALD F. HOFFMEISTER, *Museum of Natural History, University of Illinois, Urbana.*

Notes on the Barbet Genus *Eubucco* (Capitonidae) in Southern Peru.—Specimens of three species of the barbet genus *Eubucco* have recently been received in a collection of birds from the Marcapata Valley in southeastern Peru. The specimens of *Eubucco* were taken at two localities within 15 miles of each other, Hacienda Cadena at 1000 meters and Balceadero on the Rio Nusiniscato at 630 meters. All

the birds from Balceadero are tropical in their affinities, but from Hacienda Cadena there are a few subtropical forms found with the tropical species. The three species represented are *E. versicolor versicolor*, *E. richardsoni aurantiicollis* and *E. tucinkae*.

There have been three reviews of the South American barbets in recent years: Berlioz (Ois. Rev. Fr. d'Orn. [n. s.] 8: 221–239, 1938), Ripley (Auk, 62: 542–563, 1945) and Peters (Birds World, 6: 24–29, 1948). In the genus *Eubucco*, Berlioz and Peters agree in recognizing three specific units, *richardsoni*, *bourcierii*, and *versicolor*. However, Berlioz overlooked the recently described form *tucinkae* of southeastern Peru which Peters placed in the species *bourcierii*. Ripley, on the other hand, recognized only two species, lumping *richardsoni* and *versicolor*. The presence of representatives of all three specific units at one locality and the discovery of the hitherto unknown female of *tucinkae* help to clarify the relationships between the different forms.

Eubucco richardsonii aurantiicollis Sclater

Eubucco aurantiicollis Sclater, Proc. Zool. Soc., 1857 (1858): 267 (Rio Javari and Rio Ucayali, Peru).

Balceadero, 1 male, November 7, 1949; 1 female, November 14, 1949.

Eubucco versicolor versicolor (P. L. S. Müller)

Bucco versicolor P. L. S. Müller, Natursyst. Suppl. 1776: 88 (Maynas, Peru).

Hda. Cadena, 1 male, 1 female, November 26, 1948; 1 male, December 9, 1948; 1 female, May 16, 1949.

The presence of both these forms in the same region is definite proof that *richardsoni* and *versicolor* are well marked species. However, even if there were no overlap in range, there is very little reason for uniting the two forms. Within each species of the genus, the females are much less variable than the males and serve as the surest guide to specific relationships. For example, the females of *E. v. versicolor* and *E. v. steerii* differ only slightly in the shade of coloration, although the males are so different in both pattern and color that until Zimmer (Field Mus. Nat. Hist. Zool., 17: 303, 1930) demonstrated their close relationship, they were considered different species. Similarly the males of *E. r. aurantiicollis* and *E. r. richardsoni* are strikingly different, but the females differ only in the intensity of color.

The only apparent relation between *versicolor* and *richardsoni* is in the approach of males of *versicolor steerii* to the generalized pattern of *richardsoni*. However, the more conservative females differ markedly, and both are closer to the females of *bourcierii*, which are intermediate in appearance, than they are to each other. *Versicolor* is also a larger bird than *richardsoni*, with a proportionately larger bill. The separation of these two species by Berlioz and Peters is clearly the correct treatment.

Eubucco tucinkae (Seilern)

Capito tucinkae Seilern, Verh. Orn. Ges. Bayern, 11: 276, 1913 (Yahuarmayo, Carabaya, Peru).

Balceadero, 2 males, October 31, 1949; 1 female, November 10, 1949.

In his original description Seilern compared his single male of *tucinkae* to males of *bourcierii*, from which it differed in: the golden olive rather than dark green color above; the narrow yellow rather than pale blue hind collar; the more extensive red on the upper breast; and the presence of a patch of pale gray at the sides of the breast. These differences are of about the same order of magnitude as those separating *richardsoni* and *aurantiicollis*, and on the basis of the males, *tucinkae* could be considered conspecific with *bourcierii*. However, the discovery of the female of *tucinkae* casts doubt on the validity of this arrangement. The following is a description of the female of *tucinkae:*

Above: crown, cheeks, and auriculars red, the red extending down sides of neck, but not onto nape; lores black, and fine black edge to forehead; nape, back, and rump olive, brighter on rump, and with reddish-golden wash on nape and upper back (this is similar to male, but duller and lacking yellow band on nape); *below:* throat yellow with black chin spot; orange band across upper breast, with anterior edge clearly defined against yellow throat and posterior edge merging with yellow-orange of lower breast and straw color of belly; clear gray patch at side of upper breast; flanks and all but mid-line of belly broadly streaked with grayish-olive.

The female of *tucinkae* is separated from the females of all other species of the genus by the presence of red on the head. This fact, coupled with the constancy shown by the females of the other species, is sufficient to maintain *tucinkae* as a separate species rather than a race of *bourcierii*. On the basis of the resemblance between the males, *tucinkae* is probably most closely related to *bourcierii*, but its wide isolation, no member of the group being found between Ecuador and southeastern Peru, has permitted it to develop into a separate specific entity.—MELVIN A. TRAYLOR, JR., *Chicago Natural History Museum, Chicago, Illinois.*

Eastern Kingbird, *Tyrannus tyrannus* (Linné), from Brazil.—The winter range of this conspicuous North American species is stated as extending from southern Mexico to the northern part of South America—British Guiana, Colombia, Ecuador, Perù, and Bolivia (Hellmayr, Cat. Birds Americas, 5: 103, 1927). The occurrence of the bird also was supposed in Brazil; Bent (Tyler, Bull. U. S. Nat. Mus. 79: 27, 1942) quotes: "probably through western Brazil." On November 13, 1948, I obtained a specimen of *Tyrannus tyrannus* (No. A. 1125, coll. zool. Fundação Brasil Central) on the Rio Kuluene, eastern main tributary of the Rio Xingú, Mato Grosso, central Brazil. This region is situated in the center of South America; the geographical position of the place (camp "Jacaré" of the Expedition Roncador-Xingú, Fundação Brasil Central) is 12° 0′ 16″ South, 53° 23′ 45″ West, which latitude corresponds with the known wintering quarters of the species on the west coast of South America, in Perú. The Rio Kuluene region is transitory among the typical "Campo cerrado" of Mato Grosso and the "Hyleia Amazônica" in the north. The Kingbird was encountered at the border of the forest. Its plumage was worn; the sex could not be determined. This November record of *Tyrannus tyrannus* in central Brazil coinsides well with the expected time of winter migration of the species, the egg-dates from British Columbia to Florida are between May and July.—HELMUT SICK, *Fundação Brasil Central, Rio de Janeiro, Brazil.*

Gray Kingbird, *Tyrannus dominicensis*, Nesting in Alabama.—For some time I have suspected the occurrence of the Gray Kingbird at Fort Morgan, Alabama, having heard its *kit-kittery* regularly imitated by Mockingbirds there. My first trip there "in season" (May 14, 1950) proved this suspicion correct. One pair of these large tyrants was seen and heard near the north shore at the Fort, and possibly a third individual 100 yards farther west. Returning to the spot an hour later, I saw a Gray Kingbird fly to a partly constructed nest in a fire-killed live oak, *Quercus virginiana*, thus leaving no doubt regarding its breeding there. No collecting gun was obtainable, but the writer is thoroughly familiar with this species on the coast of Florida where it is common locally.

This appears to be the westernmost nesting record of the Gray Kingbird in the United States, as no previous records have been published west of Pensacola, Florida. It is also the first record of any kind for this bird in Alabama. A sight record by George H. Lowery (Auk, 63: 184–185) 32 miles off the Louisiana coast, May 11, 1945,

indicates that it may range farther west, at least casually.—HENRY M. STEVENSON, *Department of Zoology, Florida State University, Tallahassee, Florida.*

Courtship Display of the Rock Wren, *Salpinctes obsoletus obsoletus*.—On several occasions (the last on March 20, 1950) I have observed the courtship display and mating antics of Rock Wrens. In each case the birds were moving about on broad exposed rocks, at no time descending to the nearby level ground. Both birds were highly active but the male showed the greater "animation." The female, while crouching low to the rock surface, crept about in a strange zig-zag manner, reminding one of some mechanical toy. She fluffed her body feathers, fluttered her wings, and at the same time spread wide her dusky feet and tail. During this period she gave a series of faint squeaky notes. The male, with tail also widely spread and head upraised on a plane above the horizontal, flew actively about her at a distance never greater than three feet, but generally very much nearer, often alighting and showing off, now in front, now behind her. He uttered no notes. After a few rounds at this the female flew to another rock and the curious performance was repeated. In each case, such antics went on for several minutes before copulation took place. After mating the female flew to a new location at some distance, the male erratically following. Courting was resumed after a lapse of 15 or 20 minutes, and then another copulation took place.—EDMUND C. JAEGER, *Riverside College, Riverside, California.*

Another Record of the Cedar Waxwing, *Bombycilla cedrorum*, Feeding on Dragonflies.—Kennedy, in his study of birds feeding on dragonflies, found that only three of a total of 225 stomachs of the Cedar Waxwing contained dragonflies (Ecol. Monog., 20 (2): 130, 1950). The writer, accompanied by Ladd Heldenbrand and Donald McCarraher, observed at close range a Cedar Waxwing perched on a low limb at the edge of Wingfoot Lake near Suffield, Ohio, devour a large specimen of a dragonfly in the early evening of August 10, 1948. The bird struggled with the insect which nearly proved to be too large to swallow; after repeated gulping and manipulation with its bill for a minute or two, the waxwing was finally able to swallow it. The difficulty of feeding on such large prey, with other reasons given by Kennedy, probably explains why this bird seldom does so.—RALPH W. DEXTER, *Kent State University, Kent, Ohio.*

Some Observations on the Nesting and Feeding Habits of the Starling, *Sturnus vulgaris*.—During 1949 and 1950 some observations were made on the nesting and feeding habits of a pair of Starlings which nested under a window sill at Kentucky Wesleyan College, Winchester, Kentucky.

They were first observed feeding young on April 28, 1949, and all the birds had left the nest by June 21. In early April of 1950 a pair nested in the same location, and by April 11 six eggs had been laid. One of the eggs was removed but no more were laid. By April 24 all eggs had hatched, thus making an incubation period of about 13 days. More complete observations were made on the frequency of the feeding of the young at this time (Table 1). The time of the observations varied between 4:30 a. m. and 7:35 p. m., and both parents took part in the feeding, as they were often seen at the nest at the same time. The food consisted of earthworms, grub worms, insects, some vegetable matter and fruit. By May 11 the young were almost grown and were trying to get out of the nest, and by May 14 all had left the nest. Some of them were later seen on the campus following the parents which occasionally fed them.

On May 15, presumably the same pair was seen bringing straw and grass to the old nest, but only a very thin layer was added. By May 22 two eggs had been laid and

later three others, on consecutive days. Two of these were removed but no more were laid, so that five completed the clutch this time.

Because of absence from the campus at this time no further observations were made until June 11, when it was found that the eggs had hatched and the birds were quite large.

The major value of these observations on the Starling is to show the frequency of feeding of the young, which was at about six-minute intervals.

TABLE 1

Date	Young: Age in days	Young: Number	Minutes watched	Number visits	Frequency feeding per hour	Weather data* Max. and min. temp. in degrees F. Precipitation in inches
1949 April 28			200	9	2.7	max. 67, min. 48, p. 0
May 1			140	29	10.4	max. 76, min. 59, p. 0.05
1950 April 25	1	5	188	47	15.0	max. 66, min. 48, p. 0.05
April 26	2	5	38	12	18.9+	max. 66, min. 39, p. 0
April 27	3	5	54	9	10.0	max. 70, min. 46, p. 0
April 29	5	5	40	7	10.5+	max. 78, min. 47, p. 0.60
May 1	7	5	109	26	14.3	max. 61, min. 51, p. 0.02
May 2	8	5	67	8	7.2	max. 57, min. 50, p. 0.97
May 4	10	5	90	22	14.7	max. 86, min. 61, p. 0.06
May 6	12	5	159	44	16.6	max. 75, min. 50, p. 0.80
May 9	15	5	62	8	7.7	max. 79, min. 57, p. 0
May 11	17	5	197	48	12.2	max. 69, min. 53, p. 0.13
May 12	18	5	163	26	9.3	max. 59, min. 43, p. 0.46
June 15	quite large	3	75	10	8.0	sunshiny, temp. 88 at nest
June 16	"	3	104	15	8.7	
June 17	"	3	189	39	13.0+	
June 20	"	3	163	20	7.4	temp. 75 at nest
June 22	"	3	64	12	11.3	rain at nest
Total			2102	391		

The total time watched was 35.03 hours.
The average number of feedings per hour was 10.9.

* The temperature and humidity records are from Lexington Airport which is about 18 miles from Winchester.—MARY J. BROWN, *Kentucky Wesleyan College, Winchester, Kentucky.*

Alaska Myrtle Warbler, *Dendroica coronata hooveri*, in Ohio.—While examining a number of Myrtle Warblers in the University of Cincinnati collection the writers tentatively identified one as *hooveri*. This bird was collected October 9, 1948, by G. Ronald Austing in North College Hill, Hamilton Co., Ohio, about 10 miles north of Cincinnati. The sex, unfortunately, was not determinable, but it probably is a male. The specimen was sent to Dr. George M. Sutton who confirmed our identification.

The specimen was also sent to Dr. Alexander Wetmore who wrote as follows: "The Myrtle Warbler is a well marked example of the western form. This is characterized mainly by the distinctly grayish more bright brownish wash of the upper surface. This is one of the principal differences marking the subspecies." Oberholser (Bird Life Louisiana, 1938: 537) noted that "The Hoover Warbler is a winter resident in south-eastern Louisiana from Nov. 26 to April 17, apparently uncommon, but as it is not distinguishable except by specimens in the hand it may be more numerous than our present records indicate."

It seems probable that this race occurs at least casually far east of its normal range. Possibly an examination of other collections will reveal other eastern specimens.

We wish to express our appreciation to Dr. Sutton and to Dr. Wetmore for their examination of the specimen and to Dr. H. Friedmann for reading the manuscript.—Emerson Kemsies and G. Ronald Austing, *Department of Zoology, University of Cincinnati, Cincinnati, Ohio.*

Northern Redstart, *Setophaga ruticilla tricolora*, in Ohio.—In the Supplement to the A. O. U. Check-list (Auk, 66: 284, 1949) the Redstart is divided into two races, the Northern form taking the name *tricolora*, breeding northward from Central Ontario and in migration ranging to northern South America. This range seemed to indicate that this form should occur in migration in Ohio. The writers therefore attempted to secure a number of Redstarts during the fall migration of 1949. Six females were taken at North College Hill, Hamilton Co., Ohio, Aug. 31, 1948, and Sept. 12 and 13, 1949. Three of these, together with one collected the previous fall, were identified as *tricolora* and later confirmed by Dr. Wetmore. The other three were *ruticilla*. An examination of other collections will no doubt disclose other fall and probably spring specimens from Ohio. Migration data for this form in comparison with *Setophaga r. ruticilla* need to be determined.—Emerson Kemsies and G. Ronald Austing, *Department of Zoology, University of Cincinnati, Cincinnati, Ohio.*

English Sparrow, *Passer domesticus*, Parasitized by Cowbird, *Molothrus ater*.—In Baltimore, on May 4, 1950, I found an active nest of the English Sparrow containing three eggs of that bird and one of the Cowbird. The nest was built between the lintel of a porch and a bamboo awning rolled up against it; the entrance was at the top. All of the eggs had been incubated a few days. Those of the Sparrow were so heavily streaked with olive brown that they looked almost solidly that color; the Cowbird egg was heavily blotched with brown, but much of the white ground color showed. One sparrow egg was broken in being blown; the others have been given to the United States National Museum. Friedmann ('The Cowbirds,' 1929: 216) records only three parasitized nests of the English Sparrow.—Hervey Brackbill, *4608 Springdale Avenue, Baltimore 7, Maryland.*

Summer Tanager, *Piranga rubra rubra*, in Winter in Florida.—On February 8, 1950, the writers had a good view of a Summer Tanager at Clewiston, Florida. We were first attracted to the bird by its continuous calling from a dense laurel oak.

There is one previous United States winter record—February 14, 1943, at Coral Gables, Florida (Fla. Nat., 16 (3): 41, 1943).—J. J. MURRAY, *Lexington, Virginia, and* ALEXANDER SPRUNT, JR., *Charleston, S. C.*

A Neglected Description.—In 1866, Enrico Benvenuti published a paper in the 'Annali del R. Museo di Fisica e Storia Naturale di Firenze per il 1865,' (n. ser., 1: 197–209) in which he described four supposedly new hummingbirds from New Granada and "*Dendroica Picciolii*" (p. 207) from Brazil. It appears probable that there was an earlier separate account of these birds published in Florence in 1863 (which I have not seen); at any rate, the same birds were described in the 'Revue et Magazin de Zoologie' (15: 206–208, 1863) under a slightly different title from that of 1866, with more abbreviated descriptions, and with the supposed warbler named "*Sylvia Picciolii*" (p. 207). Coues noted the papers and the new names in his bibliography under the Mniotiltidae and Trochilidae, and in the section containing the titles relating to ornithology of "the rest of America," other than North America (Bull. U. S. Geol. Geog. Surv. Terr., 5 [2]: 284, 1879; 5 [4]: 550, 681, 682, 1880).

The four hummingbirds were described against the advice of Count Salvadori, and all were properly relegated to synonymy by Elliot (Ibis, (3) 6: 10, 1876). "*Dendroica Picciolii*" has otherwise escaped attention as far as I can discover, although "*Sylvia Picciolii*" was queried by Hartlaub (Arch. Naturg., 30 (2): 20, 1864) as possibly belonging to *Hylophilus* or *Nemosia*. The suggestion was excellent.

Since the paper in the "Annali" is more complete than that in the "Revue et Magazin," it furnishes the better clue to the identity of the supposed warbler. There is a short diagnosis in Latin, followed by a longer description in Italian. The two versions agree in most details and indicate a bird from Brazil about the size of *Sylvia atricapilla;* with the top and sides of the head ochraceous brown; throat yellow; back grayish olive; middle of the belly white; bill and feet plumbeous. The Italian text says that the under parts otherwise are whitish, weakly tending toward vinaceous, much duller on the sides of the breast and tending toward olive gray on the flanks; the Latin account calls the sides of the belly "pallide-violaceis"! The short diagnosis in the "Revue et Magazin" omits any description of this region of the body.

Granted that the Italian description is the most accurate, the only bird from Brazil or elsewhere in America to which it can apply is *Thlypopsis sordida*, one of the tanagers (placed occasionally in *Nemosia*). Even there the reputed vinaceous tinge is a little fanciful but not wholly misleading, and in other particulars the description is quite recognizable. Since no exact locality was given other than Brazil, it is probable that Benvenuti had a trade-skin, probably a "Rio-skin" or a "Bahia-skin"; both kinds are known of this species. In order to dispose of the name, therefore, I propose Rio de Janeiro as type locality for Benvenuti's bird (both from the 1863 and 1866 references) and indicate its position in the synonymy of *Thlypopsis sordida sordida* (D'Orbigny and Lafresnaye).—JOHN T. ZIMMER, *American Museum of Natural History, New York, N. Y.*

Florida Cardinal, *Richmondena cardinalis floridanus*, as Honey-Gatherer.—Evidently the Florida Cardinal is a honey-lover, although I have seen them sip it from but one kind of flower. At St. Petersburg, Florida, in a hedge of what is commonly called "turk's cap" or "sleepy hibiscus," *Malvavisas arboreus* var. *penduliflorus*, I noted considerable commotion caused by two or three Cardinals. The birds were hopping from one branch to another in a most business-like manner, nipping off the red blossoms with which the ground below was lavishly strewn.

Approaching as near as possible without frightening the birds away, I watched them repeatedly snip off a blossom, hold it in the uptilted beak for a second or two and then drop it to earth and move on to another blossom where the performance was repeated. After watching this activity for some time, I examined many of the discarded blossoms and found that in every one of them the calyx was slashed just where the petiole was attached to the sepals—a neat, deep incision about the length of the Cardinal's beak.—PHYRNE SQUIER RUSSELL, *Natural History Museum, Stanford, California.*

Cardinal, *Richmondena cardinalis*, Wintering in North Dakota.—On November 7, 1948, I saw a male Cardinal at Fort Yates, Sioux County, North Dakota. Fort Yates is on the west bank of the Missouri River about 60 miles south of Mandan. Numerous additional sight records were secured during the following weeks. In December, I placed a feeding shelf outside a kitchen window and within a few days we had two bright males and one female feeding regularly at the shelf. This was the greatest number seen at any one time. One male was banded on January 8, 1949. I last saw a male bird on March 7. No summer records were secured. Mrs. K. H. Lee, a reliable observer, stated that several of these birds spent the winter of 1947–48 in Fort Yates. According to Dr. S. O. Kolstoe, an accomplished ornithologist, about a dozen Cardinals spent the winter of 1947–48 on the campus of the North Dakota Teachers College at Valley City in Barnes County, 60 miles west of Fargo. It has not been determined whether any Cardinals are spending the present (1949) severe winter in that state.—HENRY C. KYLLINGSTAD, *1419 Santa Cruz Drive, Santa Fe, New Mexico.*

Doubly-occupied Nests of the Eastern Cardinal, *Richmondena cardinalis*.—On March 1, 1948, the junior author began making regular observations on a pair of Cardinals that eventually nested in a yard in Warrensburg, Missouri. The male soon established his territory and defended it against all other male Cardinals. The territory included an area approximately 120 feet wide by 250 feet long in the yards of two adjoining residences. By the last week of March, the female accepted the male and remained in his territory.

The pair began nest building on March 27. The nest was built in a rambler rose bush that climbed the side of the front porch. Cardinals had nested in this same rose bush for the past two years, and the present pair used the lower part of a nest that remained from the preceding year as a substrate for the new nest. The nest was a typical Cardinal's nest in all other respects. It was completed by March 31.

The first egg was laid on April 2 but, although the female was frequently on the nest on April 3, a second egg was not found in the nest until April 4. There is, however, the possibility that a Cowbird, *Molothrus ater*, could have removed an egg had one been laid on April 3. On April 4, a Cowbird egg also appeared in the nest, but the female Cardinal began incubation and did not pay any attention to the Cowbird egg. The female was often frightened from the nest by the passage of persons through the door of the house located a few feet away, but she returned as soon as they had left the area.

On April 11, a second pair of Cardinals appeared in the vicinity. The two males fought considerably on April 12, but on that day another Cardinal's egg appeared in the nest. The following day, two more eggs appeared in the nest. One of these was thought to be a Cowbird's egg, but it was so similar in appearance and size to the eggs of the Cardinal that its identity could not be determined with certainty.

From April 12 to April 20 there were two female Cardinals sitting or attempting to sit on the same nest. Each day during this period, both females were actually observed on the nest, facing in opposite directions. On the morning of April 17, it was found that the one known Cowbird's egg had been eliminated from the nest and lay broken on the ground. Later that morning we were able to take moving pictures of the two females together at the nest.

As nearly as it was possible to tell with unmarked birds, the male of the second pair did not come into the other male's territory except to feed his mate. At such times, he was attacked and chased if he did not leave quickly. One of the females was noticeably more aggressive than the other at the nest.

On April 21, one female deserted. Two eggs disappeared from the nest the following day and were found on the ground below. The number of eggs then remaining in the nest was three. These were incubated until May 31, which was at least two weeks over the normal period for the species. Failure of the eggs to hatch may have been due to poor incubation.

It was not until January, 1949, that we heard of a similar instance of a doubly-occupied nest of the Cardinal. Ruth Ann Young, of the Central Missouri State College Biology Department, had seen such a nesting in June, 1936. The nest was in a cherry tree at her home in Marshall, Missouri. Two females, facing in opposite directions, were often observed sitting on the nest. The eggs hatched, but it was not known whether the young were raised successfully. In this case also, Cardinals had nested in the same tree for several years.

When shown the moving pictures of the two females at the nest, Dr. Arthur A. Allen remarked upon the possibility of the second female being so attached to the nesting territory because of having previously occupied it, that she could not be intimidated. This might be possible if the second female had been one of the birds that nested in the same spot the previous year.—OSCAR HAWKSLEY AND ALVAH P. MCCORMACK, *Central Missouri State College, Warrensburg, Missouri.*

Cardinal, *Richmondena cardinalis*, Assists in Feeding of Robins.—After maintaining a feeding station during the winter of 1949 in Champaign, Illinois, my wife and I watched a family of Robins, *Turdus migratorius*, and a family of Cardinals enter into an unusual relationship. During a windstorm on April 30, the nest of the Cardinals was destroyed and the two young, which were about two days old, perished. The adults began to build again in an undetermined place two or three days later, or about the same day that a family of young Robins was hatched. The four young Robins left their nest on May 15.

On the afternoon of May 27, we were amazed to observe the male Cardinal and the male Robin feeding one of the young Robins. The adult birds worked in perfect harmony, foraging for insects or insect larvae in the immediate area and alternately feeding the young bird. This was observed again at dusk. During each of the next seven days, the male Cardinal was almost as active in feeding the four Robins as were the parent birds. This apparently began a day or two before the second set of Cardinals hatched and, once established, continued for a few days while the Cardinal had young of his own. The young Robins came to regard the Cardinal as a third parent, recognizing with "eagerness" his every appearance in the yard and following him for food which after two days of feeding solely on the ground consisted largely of cherries.

On June 8, two young Cardinals, not more than a day or so out of their nest, were being fed by the male Cardinal. During the period when the Cardinal had young in the nest, he ranged widely, bringing in food for the Robins at intervals of about one-

CHRONOLOGY OF EVENTS

	Robin	*Cardinal*
April 30		First nest and young destroyed
May 2	(Young hatching)	(Building of second nest)
May 7		
May 13	Young left nest	(Egg laying)
May 15		
May 27	Young first seen fed by Cardinal	
May 28	Cardinal feeding Robins	(Young hatching)
June 3		
June 8		Young out of nest and being fed by male

Unobserved events are enclosed by parentheses

half hour. This suggests that the Cardinal was not neglecting his own family but was striving to raise two families simultaneously. It is interesting to note that the Robins were but a few days younger than the first set of Cardinal young which perished. The female Cardinal did not feed the robins, nor did the male when the female was in the yard.—STANLEY LOGAN, *6107 Newburg Ave., Chicago 31, Illinois.*

Young Evening Grosbeaks, *Hesperiphona vespertina*, at Saranac Lake, New York, 1949.—A bird that has attracted considerable attention during the past 60 years in New England, the Middle Atlantic States, the Great Lakes States, including the Provinces of Ontario and Quebec, has been the rather rare, striking and easily identified Evening Grosbeak. The interest in this colorful bird has greatly increased during the past decade, and its presence in many villages and cities of the northeastern states is becoming an almost annual event during the period from November to the middle or latter part of May (Mason and Shaub, Bird-Banding, 20: 169–179, 1949).

In New England the records of young birds begin on July 12–14, 1926, when two adults and four young were observed by E. K. Wright and Richard M. Marble (Auk, 43: 549, 1926) at Woodstock, Vermont. On July 28, 1937, Harry C. Holton saw an adult male at Mt. Hermon, Massachusetts, and the next day a very "young bird more buff or brownish than the female" (Bagg and Eliot, 'Birds of Conn. Valley in Mass.,' 1937: 788).

The first record of young for the state of Maine was of an immature bird with an adult male which came to a feeder at Presque Isle for several days, commencing August 4, 1946 (G. D. Chamberlain). An immature was seen early in July, 1946, by Mrs. Harry G. Whitney of Hampden Highlands, near Bangor (Palmer, 'Maine Birds,' 1949: 526).

From the above resume, it is certain that the appearance of the young of the Evening Grosbeak in the United States east of the Upper Peninsula of Michigan is far from common. However, it is more or less apparent that the appearance of the species in summer (Baillie, Can. Field-Nat., 54: 15–25, 1940) and its breeding range have been gradually extended eastward during the past three decades.

Young Evening Grosbeaks in company with the adults were seen at 51 Franklin Avenue, Saranac Lake, by Miss Ruth Hagan in 1947. Again in 1948 the parent birds brought their young to the same feeding station. Miss Hagan informed the writer that as many as eight young, together with the adults, were present on her feeding tray in 1948. Each year both the old and young left before the end of the summer.

On the afternoon of May 19, 1949, I stopped at 51 Franklin Avenue between 5 and 6 p. m. and saw 15 to 20 grosbeaks in the green foliage of a tree close to and partly overhanging the house.

Upon my return to Saranac Lake in the early part of June, two or three pairs of grosbeaks were reported coming to the feeding station at 51 Franklin Avenue and also to the feeding tray of Mr. and Mrs. G. H. Hodgkins at 112 Lake Street. At the latter place a pair was reported to have carried nesting material into a tall spruce tree near by, but the nest-building was quickly abandoned. The adult birds continued to visit regularly these feeding stations throughout June and July. A young grosbeak was reported at 51 Franklin Avenue on June 15 and again on June 19. This is the earliest date reported for the appearance of young grosbeaks within the Great Lakes area and eastward.

On July 2 a male grosbeak was reported to have brought another young to 51 Franklin Avenue. It was said to be very much grayer than the previous ones. This young remained in the tree near the house and was frequently fed by the male grosbeak. On July 7 I saw this bird and at once recognized it as a young Cowbird, *Molothrus ater*, at least a week out of the nest. At this time the male grosbeak energetically and hastily shelled sunflower seeds at the feeder and made eight trips in quick succession from the tray to the Cowbird as it sat upon a limb with partly outstretched, quivering wings; but then it refused more food. This appears to be the first time that the Evening Grosbeak has been observed to be parasitized by the Cowbird.

At no time could any evidence of food be seen in the grosbeak's bill; hence the five to ten sunflower kernels must have been held in the back part of the mouth or throat when carried to the young. On July 11 the male grosbeak and the young Cowbird were again seen, but at this time the grosbeak's interest in the Cowbird had greatly lessened; he was reluctant to feed it and only did so after much begging for food on the part of the young Cowbird.

As yet no nests of the Evening Grosbeak have been located at Saranac Lake or in the vicinity; hence it cannot be said positively that a grosbeak's nest was invaded by a Cowbird and that the young Cowbird was actually incubated and reared by this bird and its mate.

On July 3, 1949, I first saw one of the young Evening Grosbeaks and the adult male at 112 Lake Street. The male made several trips from the feeding tray to the young perched on a branch of a maple tree. The immature was well feathered, active and probably ten days or two weeks away from the nest.

The young birds would sometimes remain on the feeding tray at a distance of 2.5 feet while the camera shutter was reset. At this distance, I could, at times, clearly see a large bird-fly, *Hippoboscidea*, move about the neck feathers of one of the females.

The outstanding characteristic action of the immature grosbeaks, when on the feeding tray was their extremely slow, deliberate and measured motions. Upon alighting on the tray, often with a pronounced thud, they would hold rigidly their initial posture for approximately five seconds and would then slowly move their heads or bodies into some other position and carefully survey the tray for food. When an acceptable object was located they would slowly stretch their necks and pick it up. At first the young had considerable difficulty in cracking the sunflower seeds and extracting the kernel. They would turn the seed over and over in their mouths in attempts to crush the hard cover. They did not move about much on the tray and usually kept away from the numerous active and bothersome Purple

Finches, but as they grew older they were less on the defensive and soon became more belligerent.

The last of the adult birds, a molting female, was seen on August 7. On August 15 the last immature bird was seen.

An immature male was found dead beneath the feeding tray at 51 Franklin Avenue on July 24.

The selection of the vicinity of Saranac Lake as a breeding place may be due to the abundance of food, supplied by the residents of the village, which delayed the departure of some of the birds that nest early. The similarity of the Adirondack region to the Canadian areas where they have been seen in the breeding season may also be an important factor.

The writer wishes to acknowledge his appreciation and thanks to Dr. Gordon M. Meade, Mr. and Mrs. G. H. Hodgkins, and Miss Ruth Hagan for their assistance while observing and photographing the young. He is also indebted to Mr. Samuel A. Eliot, Jr. and Mr. Edwin A. Mason of Northampton, Massachusetts, and to Mrs. Doris H. Speirs of Pickering, Ontario, for suggestions concerning the manuscript.

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B. M. Schaub, *159 Elm St., Northampton, Massachusetts.*

The Occurrence and Possible Significance of a Spring Molt in Leconte's Sparrow.—As nearly as can be ascertained from the accounts of Dwight (1900: 188–193) and other authors, the only North American emberizine finch of the "sharp-tailed" group known to undergo a complete spring molt is the Sharp-tailed Sparrow, *Ammospiza caudacuta*. Leconte's Sparrow, *Passerherbulus caudacutus*, is not treated in Dwight's work, and we found little in the subsequent literature in regard to its molts. However, Chapman (1910: 18) said the "spring molt [of Leconte's Sparrow] is confined to the head and breast." Accordingly, it was a matter of interest when extensive molt was noted in a series of five Leconte's Sparrows collected in April, 1950, in Marshall County, Kentucky, by Mengel. We have therefore undertaken a careful examination of 35 specimens in the University of Michigan Museum of Zoology, taken in February, March, April, and May.

Two of the Kentucky specimens were plucked and examined minutely. We examined the remainder of the specimens under an 18-power binocular microscope for indication of feather wear and replacement. New and incoming body feathers can be readily distinguished from old feathers by this method. Rectrices and remiges were also examined for evidences of molt. Where basal sheaths are present there can be no doubt that the feathers are new; however, with wear alone as a criterion, the matter is more difficult. We believe that the age of rectrices can be judged with some accuracy under a lens, but considerable uncertainty remains in regard to remiges.

The spring molt evidently begins in late March or early April. Three February specimens from Texas are in worn plumage with no indication of recent feather replacement. Of six specimens, from various localities, taken from March 20 to 31, the only molting bird is a female from Matagorda, Texas, collected on March 31, 1936, by H. H. Kimball. This bird has a considerable admixture of fresh feathers on the throat, breast, and belly, indicating that molt must have begun at least several days previously. There is, however, no evidence of molt on the upperparts.

Of 12 April birds eight taken on or after April 12 were actively molting or had nearly completed the molt; four collected on or before April 8 were not molting. The nature of the molt can best be described from the freshly collected Kentucky specimens referred to above. These lent themselves to more complete examination, and the molt in them appears to be similar to that in older study skins. Typical of the height of the body molt is RMM No. 1183, a male, taken on April 16, 1950. This is described below: crown, lores, chin, cheeks, nape, dorsal tract, scapulars, ventral tract, and upper tail-coverts all in heavy molt; under tail-coverts in light molt; femoral and crural tracts molting; slight molt in under wing-coverts, probably nearly complete; middle four or five greater secondary coverts lacking, or short and sheathed, the molt apparently progressing from proximal to distal; no perceptible molt in lesser or middle coverts, but these feathers seem fresh and may already have been replaced; innermost secondaries (*i. e.*, tertials) being replaced. Two other Kentucky specimens, RMM Nos. 1174 and 1175, both males taken on April 15, have almost completed the body molt and are in fresh, unfaded plumage.

Fourteen May specimens at hand, collected for the most part on the breeding grounds in North Dakota, Alberta, and Michigan, but including one taken on May 1, 1936, at Matagorda, Texas, are entirely in unworn, unfaded body plumage, indicating that a molt has been recently completed.

We found no positive evidence of molt of remiges other than that involving the tertials. Comparison of birds taken in late winter and early spring with specimens taken in May indicates, in general, greater wear of primaries and secondaries in the May birds.

The tail molt is considerably more difficult of analysis. The majority of late spring specimens seems to have had no spring tail molt whatever. On the basis of sheathed rectrices, only four of the 35 Leconte's Sparrows were indisputably molting their tail feathers. Three of these were May birds which had completed the body molt, and in all three the tail molt was asymmetrical, involving one, four, and seven feathers respectively. These feathers may, of course, have been lost by mishap. However, the possibility that a complete tail molt does occur in some individuals in spring is suggested by RMM No. 1183, whose body molt was described above. In this bird the tail was full grown and unworn, with the four outer left and two outer right feathers sheathed at their bases. The tail feathers of several other specimens, including RMM No. 1184, seem to be insufficiently abraded to have been worn since the previous autumn.

We have not emphasized color differences between early and late spring specimens, since we feel that more objective criteria are desirable in estimating age of feathers. Nevertheless, comparison of early and late spring birds in series clearly shows richer coloration in the latter, especially on the under parts. Furthermore, the light edgings on the feathers of the upperparts, which are lacking or much reduced in late winter birds, are present again in late spring. Subsequent wear and fading, after commencement of breeding activities, are rapid and marked.

The spring plumage acquired by the molt here described differs slightly but definitely from fresh fall plumage. The faint necklace of dark streaking on the breast usually characteristic of fresh fall specimens is nearly or totally lacking in the newly molted spring birds we have seen. It might be assumed that these streaks have been lost by wear, but even worn late winter birds usually have some remnant of these markings. The dorsal plumage in spring lacks some of the richness of tone (*i. e.*, abundance of warm browns at the expense of black) present in fall.

This consideration of the molts of Leconte's and other "sharp-tailed" sparrows brings up the question of the relationships of these birds. At one time, *Ammospiza* and *Passerherbulus*, as now understood, were considered congeneric (*"Ammospiza,"* of Oberholser, 1905: 68; *"Passerherbulus,"* of American Ornithologists' Union Check-List, 1910: 257–260). Oberholser (1917: 332–336), in a discussion of the generic relationships of the "sharp-tailed" sparrow group, placed the species then known in four genera (*"Thryospiza"* including *Ammospiza maritima* and *A. nigrescens; Ammospiza caudacuta; Passerherbulus "lecontei"* [= *caudacutus*]; and *"Nemospiza"* for Henslow's Sparrow, *Passerherbulus henslowii*). Oberholser separated his genera *Ammospiza and Passerherbulus* on the following grounds:

"[*Passerherbulus*].—Wing decidedly more than four and one-half times length of exposed culmen; tail about equal to wing; first primary (counting from outermost) longer than fifth.

"[*Ammospiza* and *Nemospiza*].—Wing not decidedly more than four and one-half times length of exposed culmen; tail decidedly shorter than wing; first primary (counting from outermost), not longer than fifth."

None of these characters in itself seems to us to be of greater phylogenetic significance than the presence or absence of an extensive prenuptial molt (although in some species, the number of annual molts varies in different subspecies (see Mayr, 1942: 50–52)). Within the genus *Ammospiza* the species *maritima* has no trace of such a molt (Dwight, 1900: 193), while *Ammospiza caudacuta*, as previously mentioned, has a complete spring molt. In Henslow's Sparrow, probably only a partial replacement of the feathers of the head and chin takes place in spring (Dwight, 1900: 191–192), while in Leconte's, as here shown, the spring molt is very extensive. Although further study is required, we conclude that the evidence suggests a closer relationship between *Ammospiza caudacuta* and *Passerherbulus caudacutus* than the currently accepted classification (American Ornithologists' Union Check-List, 1931: 337–338) indicates. In addition, Leconte's and Sharp-tailed sparrows are remarkably similar in song, juvenal plumage, and (in inland populations of Sharp-tails, at least) habitat selection.

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—HARRISON B. TORDOFF AND ROBERT M. MENGEL, *University of Michigan Museum of Zoology, Ann Arbor, Michigan.*

Scott's Sparrow, *Aimophila ruficeps scottii*, a New Bird for Kansas.—While examining a series of miscellaneous unidentified and uncatalogued skins of birds in the collection in the Museum of Natural History of the University of Kansas, I found a male specimen of a Rufous-crowned Sparrow, *Aimophila ruficeps*, which was taken in Schwarz Canyon, Comanche County, Kansas, on June 7, 1936, by C. W. Hibbard. Comparative study showed that it belongs to the subspecies *A. r. scottii* which, according to the A. O. U. Check-List of North American Birds (1931: 342), ranges northeastward only as far as southeastern Colorado. This is the first record of this bird in Kansas. Our knowledge of the birds of southwestern Kansas is incomplete, and this species may be resident there in summer since the bird was taken in the nesting season. The specimen is now number 29222 in the collection of the Division of Birds.—R. W. FREDRICKSON, *Museum of Natural History, University of Kansas, Lawrence, Kansas.*

Development of White in Tails of Juncos, *Junco hyemalis*.—Variations in the white areas in the tail feathers of Slate-colored Juncos, *Junco h. hyemalis* (L.), have received some attention. A few juncos trapped for banding offered an opportunity for observation, although no nestlings or fledglings were seen for a definite determination of age.

Between November, 1929, and March, 1948, we banded 170 juncos of which 32 (18.8 per cent) repeated the same winter, and 13 (7.6 per cent) returned during subsequent seasons. During four winters, 113 drawings were made of the configurations of the white areas in the three outer tail feathers of 74 juncos. All these juncos had the first pair of rectrices completely white, except one which had light gray tips to the first and second feathers. The second rectrices were entirely white in 53 per cent of the birds. Because the returning juncos seemed to show an increase in the amount of white it was decided to collect feathers as better evidence of actual conditions.

From November, 1938, to April, 1948, the involved rectrices were plucked from 56 individual juncos, from some over periods of three or four years. Eleven of these juncos repeated in the traps the same season when banded and eight returned during subsequent winters. All 56 juncos had the first outer pair of rectrices completely white, except one or two; and in 19 the second outer pair was wholly white.

These collected feathers revealed certain characteristics of feather growth in Slate-colored Juncos. The feather vane is normally uniformly white or slate-colored, but two instances of mottling were seen. The mottled appearance was apparently caused by some of the dark diurnal growth bars retaining the slate-color longer than the intervening bars which are developed during the night. In the changing juvenal feathers, the rachis becomes white faster than do the vanes.

Junco No. 42-169079, banded November 4, 1945, and judged by streaks on the breast to be a young bird, showed in its plucked third rectrix 18 per cent white, measured by a cellophane counter of one and two square millimeters. The bird was trapped the following winter, and the succeeding feather from the same papilla measured 40 per cent white. This amount remained constant in the following feathers present 12 and 15 months later. These later uniform feathers were adult, without doubt, while showing nearly half the area white.

Juncos do not molt during the winter. Juvenal outer tail feathers which are plucked during the winter will be succeeded, not by feathers of duplicate design, but by feathers having the color pattern at the time of the next molt, due some months later.

From junco No. 42-169011, banded December 24, 1943, the third right rectrix was plucked and found to have only 16 per cent white; the succeeding feather collected February 7, 1944, measured 70 per cent white. This was another sudden winter transition from juvenal to adult plumage. Another junco, No. 44-14954, with 20 per cent white in the collected third rectrix, had twice that amount six weeks later in the succeeding feather. Junco No. 42-156538, with the two outer feathers entirely white and the third measuring 27 per cent white on January 3, 1943, increased the area in the following feather to 34 per cent white a year later; the next year this area was the same size; this suggests that the adult third rectrix may be only one-third white. This was also shown in junco No. 44-14927 in which the area increased from 13 to 34 per cent and remained there. Another junco of unknown age had 77 per cent white, which increased to 86 per cent. These limits of 34 and 86 per cent white in the probable adult plumage represent individual variations.

Dr. G. Hapgood Parks wrote me that a junco banded in Maine as a nestling, returned a year later, mated with her banded father, and raised a family. This shows that a junco may be sexually mature in one year, although at that time having a "juvenal-type" plumage. The next year she returned and mated with her banded brother, at which time her outer rectrices were entirely white, but the second was "white with a gray area near the base." Her two year old brother "showed outer and second feathers completely white," suggestive that the male develops color patterns more rapidly than does the female or that it normally has more white.

Paired tail feathers in juncos normally are symmetrical in the amount and shape of the white patches, because they are developed at the same time. Where they occasionally are unsymmetrical in the juvenile bird the feather having the more white was developed later. Removal of a feather can apparently advance the preseasonal development of feathers of succeeding molt design.—HAROLD B. WOOD, *3016 North Second St., Harrisburg, Pennsylvania.*

Behavior Responses of the Slate-colored Junco, *Junco hyemalis hyemalis*.—An experiment in which five Slate-colored Juncos were subjected to a series of electrical shocks was recently conducted in the Ornithological Laboratory of Ohio State University. This experiment was designed in such a manner that the birds were given alternate courses to reach food and water without being shocked: (1) they could hop over the shock-wires onto the edges of the trays; (2) they could reach over the wires with a slight stretching of the neck; or (3) they could fly directly to the food and water. A cage 74 inches by 26 inches by 25 inches was used, and the side toward the observer was thoroughly curtained. The curtain was fitted with a small peep hole through which observations were made. Observations were made both before and after shock was applied and extended for one or two hours each time after the food and water were daily placed in the cage. Shock was not applied between the periods of observation. Each bird was marked for individual identification. All of the birds had been held captive six or more months prior to the time of the experiment.

During the first period of observation each bird hopped over the wires after it had received an initial shock experience. The birds continued to hop over the wires without further shock experiences through the remainder of the two-hour period of observation. Likewise, on the second day the birds invariably hopped over the wires after each had received an initial shock experience. On the third day the first

shock was followed with a different pattern of behavior. The first bird to reach the food did so by reaching over the wires, and the other birds did likewise following the initial shock experience of each. This course to the food was not varied further during the third period of observation. On the fourth day the first bird to experience shock gave an alarm call, and all of the birds were immediately flying wildly about the cage. But calm was soon restored, and one of the birds hopped over the wires to food. All of the other birds then did likewise after each had received an initial shock experience, and the pattern of behavior was set for all of the birds during the remainder of that period of observation. On the fifth day each bird again received an initial shock experience. The first bird to reach the food then did so by hopping over the wires, and this became a uniform course to the food through another period of observation.

During every period of observation each of the birds received an initial shock experience. After the initial shock one of the birds hit on a course to food in which no shock was encountered, and this invariably became the route to the food for all of the birds during the remainder of that observation period. Individuals which had not yet received an initial shock experience before one of the birds had established a course to the food and water failed to adopt the course until after the initial shock experience. The response of the group to the alarm call of an individual was somewhat different in that response was simultaneous on the part of all individuals.

These Slate-colored Juncos showed a different pattern of response to the same stimulus in the face of alternate possibilities for expression. The pattern for hopping over the wires was set twice by the same bird and once each by two other birds; the pattern for reaching over the wires was set by one of the above birds which had once earlier set the pattern for hopping over the wires; and the "frenzied" state was initiated by a fourth bird. An appropriate auditory stimulus, expressed by one bird, was immediately effective at inciting a new pattern of behavior in each member of the group or a uniform pattern for the group. The tactile stimulus studied in this experiment seemed to need visual reinforcement before a new pattern of behavior was expressed by successive individuals. After the lapse of 22 hours the birds needed to be "reminded" of the disagreeable effect of the wires, but one shock experience daily caused the birds to avoid the wires through a two-hour period of observation, providing the method of access to the food and water had been established.

Apparently the behavior of these Slate-colored Juncos was a "follow the leader" process. The leader was the first bird in the situation, but the same bird did not always act as leader. This type of response is well adapted to a bird with the gregarious habits of the Slate-colored Junco.—PAUL A. STEWART, *8640 N. State Rd., Westerville, Ohio.*

On Enemy Recognition.—Frequently one finds the statement that when birds attack some other animal it proves they consider it an enemy. This may be the case, though my own rather extensive experiments on enemy recognition in thrashers (Bull. Amer. Mus. Nat. Hist., 78: 213–242, 1941) indicate the matter is more complex.

The invalidity of the general conclusion that attack proves recognition is well illustrated by comparing two notes in 'The Auk' for October, 1950. On page 512, F. C. Cross reports Chimney Swifts, *Chaetura pelagica*, pursuing a Sparrow Hawk, *Falco sparverius;* on page 518, Malcolm Davis records Purple Martins, *Progne subis*, "dive bombing" model airplanes of a particular purple and yellow pattern. Cross' tentative conclusion is that the Chimney Swifts recognized the hawk as an enemy, or had been molested by it; presumably the rather absurd conclusion follows that the

Purple Martins recognized the purple and yellow model airplane, out of various other types, as an enemy or had been disturbed by it.

As the Purple Martins attacked only a purple and yellow model airplane, one might consider the matter from the viewpoint of the "releaser" school of behavior. The yellow and purple pattern would presumably be the "releaser." But it is difficult to imagine where that pattern, deep purple with a yellow diagonal streak across each wing, is repeated in an actual predator on Purple Martins.

If possible, one should not discard ideas without replacing them by better; though rather than having obviously wrong theories it is better to admit grouping in the complexities of biological observations for correlations. Pursuit and attack of an object by birds seems a complex thing; it appears to be, at times, the attack on an enemy; at times a response to a strange object; at times the result of over-belligerence; and at times play. More than one factor could operate at once. The size, shape, and color of the object could have an effect, as well as its motion, especially in relation to the bird. All this, too, without relation to the internal state of the bird that might behave differently at different times.—A. L. Rand, *Chicago Natural History Museum, Chicago, Ill.*

Four Additional Species for Panamá.—In the course of ornithological studies in the Republic of Panamá it was my good fortune to have the privileges of La Jagua Hunting Club for a period of three weeks in March, 1949. The location is on the savannas of eastern Panamá province, about 12 kilometers east by south of Pacora, and three kilometers in airline north by west of the small village of Chico, near the coast. Extensive marshes and ciénagas, bordered by forest and broad, open savannas, made this an exceptionally favorable place for aquatic birds. Mr. Watson M. Perrygo of the U. S. National Museum, who accompanied me, and I are much indebted to Mr. Karl Curtis and his fellow club members for allowing us the club privileges and for much pleasant and friendly hospitality during our stay. The records of the four species of birds here reported for the first time in Panamá are one result of our investigations. The complete report of our extensive collections will be incorporated for publication in a combined report on the birds of eastern Panamá.

Ardea cocoi, Cocoi Heron.—On March 30, 1949, we watched an adult for a quarter of an hour on the open muddy expanse of Ciénaga Santo Domingo, in the region between Pacora and Chico. The bird was in company with a large scattered group of Wood Ibises, Egrets and a dozen or so Great Blue Herons that were feeding in the shallow water and mud bars of the lake, now partly dry as the date was toward the close of the dry season. The black crown and pale color characteristic of this bird were easily evident, and through our glasses we could see the finer details of the color pattern, so that there was no question of the identification. The contrast with the much duller colored Great Blue Herons near by was apparent even with the unaided eye. While we were trying to plan some means of approach a distant shot startled all of the feeding birds, and the heron disappeared. Half an hour later I saw it flying overhead, when again its light color was easily apparent. Baldomiro Moreno, our helper and a skilled hunter, had never seen one before. The species ranges widely throughout South America, but has not been reported previously in Central America.

Plegadis falcinellus falcinellus, Eastern Glossy Ibis.—On March 18, 1949, at Ciénaga Campana, near the coast at Chico, I found three feeding together in the open. As they rose in flight I shot one, an immature male that is now in the U. S. National Museum. Natives knew it as the Coco Negro, and said that it was fairly common. The latter statement may be taken to mean that the White-faced Glossy Ibis prob-

ably occurs here also, since, from the greater abundance of that species in the New World, it is one that would be expected. From the record one is led to speculate on the possibility of nesting colonies of *Plegadis f. falcinellus* in America in addition to those now known in Texas, Louisiana, Florida, Puerto Rico, Hispaniola, and Cuba. Otherwise, we may suppose that the small flock came from one of the West Indian colonies. Apparently this is the first record of the species for Central America.

While there has been considerable difficulty over identification of immature *Plegadis* from North America, the two species are found to be readily separable once the characters are known. *P. f. falcinellus*, the Eastern Glossy Ibis, has the back, wings, and tail deep oil-green, and the general appearance of the dorsal surface blacker. In *P. mexicana*, the White-faced Glossy Ibis, back, wings, and tail are lighter green, with a definite brassy sheen, and the dorsal surface is distinctly lighter, more grayish brown. It seems necessary to regard the two as specifically distinct in view of the scattered breeding colonies of *falcinellus* through part of the range of *mexicana*.

Theristicus caudatus caudatus, GUIANA IBIS.—Through Mr. Karl Curtis of Gamboa, Canal Zone, the U. S. National Museum has received a specimen shot near San José in the savanna region a few miles from Pacora on September 18, 1950. Baldomiro Moreno, who secured it, reported that he killed it from a flock of four. The species, which ranges in South America from Colombia and Venezuela to north Argentina, has not been reported previously in Central America. Mr. Curtis who has hunted regularly in this area during his 45 years of residence in the Canal Zone writes that this ibis was wholly unknown to him, to the natives, and to his hunting companions.

Sarkidiornis sylvicola, SOUTH AMERICAN COMB DUCK.—On the evening of May 29, 1949, at La Jagua Hunting Club, Baldomiro Moreno shot one of these ducks while night hunting for pato real. No one here had ever seen this species though we were told that five had appeared on the marshes two or three days earlier. The specimen, prepared as a skin for the U. S. National Museum, was an immature male, with the comb small and the testes in resting stage. The body was very fat. Mr. Karl Curtis wrote me that on May 20 and 21, 1949, he saw three Comb Ducks together, and one flying alone. The species ranges widely in South America from Colombia and Venezuela to northern Argentina and, as it is strong-flying, may be expected to come with some rarity to the marshes on the savannas of eastern Panamá.—ALEXANDER WETMORE, *Smithsonian Institution, Washington 25, D. C.*

Land Birds Feeding on Crayfish.—It is known that the diet of the Crow, *Corvus brachyrhynchos*, contains an immense variety of vegetable and animal matter. However, recorded instances of the Crow feeding on crayfish, *Cambarus* sp., seem to be few and only a sketchy account is given of such feeding habits by Bent ('Life Histories of North American Jays, Crows, and Titmice,' 1946). I had often observed the Crow wading along small streams, sloughs, and backwaters searching for food but I was always unable to determine the type of food until August 10, 1949, when I saw a pair of Crows at Nobis Slough in Scott County, Iowa, wading along the mud flats covered with about three to four inches of water. They would seize crayfish, throw them up on dry land, and start to peck at various portions of the exoskeleton; it took some time before the vital internal organs were affected. The two Crows were feeding in the company of migrating American Egrets, *Casmerodius albus*.

On May 30, 1949, along Duck Creek in Scott County, Iowa, I observed a female Bronzed Grackle, *Quiscalus quiscula*, capture a crayfish about three inches long. The Grackle was pecking hard at the carapace but had some difficulty in killing the crustacean. In past years I have observed Grackles feeding on these aquatic in-

vertebrates in a similar manner.—James Hodges, *324 West 31st Street, Davenport, Iowa.*

Taxonomic Notes on South American Birds.—When I was at the British Museum of Natural History in London and at the Muséum National d'Histoire Naturelle in Paris during the early spring of 1950, I examined a number of currently recognized New World "species" that are not represented in any collection in the United States. The following notes should clarify the status of some of these. But first I wish to thank those in charge of the bird collections in the above institutions for their courtesy and assistance.

Chubbia imperialis (Sclater and Salvin), Imperial Snipe.—De Schauensee considers that this bird is "perhaps not a valid species" (Caldasia, 5, (23): 444, 1949), but it differs strikingly from *jamesoni* Bonaparte. Upper parts are rufous, broadly barred with black; outer rectrices uniform sepia, not barred; anterior under parts rufous, barred and mottled with black and posterior under parts (posterior to upper breast) white, boldly barred with black. Mrs. Meinertzhagen refers *imperialis* to the genus "*Homoscolopax*" Mathews (Ibis, 1926: 514), but I agree with Hellmayr and Conover that it should be included in *Chubbia*.

Otus ingens (Salvin), Salvin's Screech Owl.—After examination of the type of *ingens* (from Jima, Ecuador) in the collection of the British Museum of Natural History I have no doubt that it is conspecific with "*Ciccaba minima*" Carriker (from Santa Ana, Río Coroico, Bolivia). These two owls should therefore be known as:

Otus ingens ingens (Salvin)

Otus ingens minimus (Carriker)

The sex of the type of *ingens* is not given, but it may well be a female, which would account for its large size (wing, 210 mm.). The type of *minimus* is an adult male and is somewhat smaller (wing, 196 mm.). Although no direct comparison of the two birds has been made, it may be said that *minimus* is on the whole less rufescent than *ingens* and there are fewer and less conspicuous black shaft-streaks on the upper breast and a greater amount of white on the scapulars. There is also some difference in the markings on the quills, which are rather uniformly barred dull cinnamon and black in *minimus*. In *ingens* the primaries are mostly dusky on the inner webs, the outer webs barred blackish and brown, ochraceous and white.

Carriker stated when describing *minimus* that in some respects this owl resembles a large *Otus*, "except for the absence of ear-tufts" (Proc. Acad. Nat. Sci. Phila., 87: 314, 1935). However, short "ear-tufts" are quite evident in the type of *minimus*, the feathers extending over the whitish nuchal collar as in *ingens*.

Pithys castanea Berlioz, Rufous-backed Antcatcher.—The type and only specimen known of this recently described antbird was one of the most interesting specimens that I examined in Europe. The bird differs from the well known *P. albifrons*, the only other species of the genus, primarily in lacking the extraordinary head plumes. In addition, it is larger, has the entire upper parts rufous like the under parts, and has a broad white post-ocular stripe. The bill and feet are similar in both species.

I have no doubt that *P. castanea* represents a primitive *Pithys*. Unquestionably it is properly placed in this genus.

Heterocercus aurantiivertex Sclater and Salvin, Orange-crowned Manakin.—Until recently this species was known from three adult males in the British Museum collected by Buckley at Sarayacu, Ecuador. In 1936, Carlos Olalla and his sons obtained for the Paris Museum six more specimens, including two adult males, at Lago Ciguin, Oriente, Ecuador. I have examined all these.

Females of this species differ from males merely in lacking the bright orange coronal patch. An immature male (now in the collection of the Academy of Natural Sciences of Philadelphia) from Lago Ciguin resembles the adult female in coloration. In comparison with an adult female *flavivertex* from "Pará" the bill is shorter and wider. The much wider primaries are presumably a sign of immaturity. Its wing measures 78.5 mm., the exposed culmen 11, and the tail from base of middle rectrices 46.5. In color the upper parts are duller green (more olive-green) and the under parts, apart from the chin and throat, are ochraceous rather than chestnut.

Hellmayr has stated that an immature male from Chamicuros, Peru, resembles *aurantiivertex* except that "the few bright feathers just appearing in the middle of the crown are golden yellow" (Birds Amer., pt. 6, 1929: 91, footnote 2). This would indicate that there is an intermediate form serving to connect specifically *aurantiivertex* with *flavivertex*.

M. Berlioz informs me that the type and only known specimen of *H. luteocephalus*, formerly in the Paris Museum, is almost certainly no longer extant, and that it was not among the types sent to the country during the Second World War. Fortunately, Hellmayr carefully described this specimen before it was lost.

Tangara arnaulti Berlioz, ARNAULT'S TANAGER.—Known only from the unique type in the Paris Museum. The bird appears to be a hybrid *T. castanonota* by *T. cayana*.

Tachyphonus valeryi (J. and E. Verreaux), "BLACK-SHOULDERED TANAGER."—The two mounted specimens in the Paris Museum labelled "*Tachyphonus valeryi*" are unquestionably referable to the icterid *Lampropsar t. tanagrinus* (Spix) with which M. Berlioz and I compared them.

Rhynchothraupis mesoleuca Berlioz, BRAZILIAN BLACK-AND-WHITE TANAGER.—I examined the unique specimen of this interesting bird in the Paris Museum and thought it probable that it should be considered congeneric with the Peruvian *Conothraupis speculigera* (Gould), although I felt it necessary that the two birds should be compared. Accordingly, I sent an adult male of the much larger *C. speculigera* to M. Berlioz and have received the following information from him. He states that "*Rhynchothraupis*" *mesoleuca* may "be considered quite reasonably congeneric" with *Conothraupis speculigera*. Both are of the same tanagrid type, and the slight differences in the shape of the bill are not of generic significance. The shape of the tail is distinctly different in the two birds—more elongated and graduated in *speculigera*, and much more shortly rounded in *mesoleuca*. The feathers of the crown are more elongated in the male *speculigera* and there is a large concealed white patch on the nape. The bird thus appears to have a rudimentary crest. In *mesoleuca* the feathers of the pileum are not elongated and there is no trace of white on the nape. On the other hand, *mesoleuca* has a small concealed white patch on the throat, lacking in *speculigera*. There is more white on the under parts in the male *speculigera* and the under tail-coverts are entirely white, not largely black as in *mesoleuca*. The white alar speculum is also more extensive in *speculigera*. Finally, the rump is gray in the male *speculigera*, not black like the remainder of the upper parts as in *mesoleuca*. M. Berlioz concludes that the two birds "are perfectly distinct species of the same genus, showing a close parallelism in color-pattern." Therefore, it appears that "*Rhynchothraupis mesoleuca*" Berlioz is an excellent species, but should be known as *Conothraupis mesoleuca* (Berlioz).

I think it likely that the type of *C. mesoleuca* is a male, although no sex is indicated on the label. M. Berlioz informs me that Dr. Vellard, who collected the specimen, said that the species was common at the type locality ("Juruena, northeast (= north-

west?) of Cuyaba, Matto Grosso, Brazil").—JAMES BOND, *Academy of Natural Sciences, Philadelphia, Penna.*

Notes on Birds of Islands in Great Salt Lake.—During the summer of 1949, I had the opportunity of briefly revisiting two islands in the Great Salt Lake, Utah. Although the time was devoted almost entirely to collecting mammals, some brief notes were made of birds observed. Several additions to the lists from 1938 (Marshall, W. H. and Leatham, L. J., "Birds of the Great Salt Lake Islands" Auk, 59 (1): 35–45, 1942) were noted.

For the period June 22–24 birds seen on the "Benchlands" of Stansbury Island were the same as those reported for 1938 except for one Nuttall's Poor-will, *Phalaenoptilis n. nuttallii*, at the north end of the island, and several Ash-throated Flycatchers, *Myiarchus cinerascens*, and two Barn Swallows, *Hirundo r. erythrogaster*, at the cabin built near the sheep corral at the south end of the island. The corral and cabin had been added to the environment since 1938 and may explain the addition of these two species. We did not visit the "original island" areas.

On June 29 while approaching Dolphin Island on foot across the salt flats, two Snowy Plovers, *Charadrius alexandrinus*, were observed along the edge of the lake waters. Later that evening a lone California Gull, *Larus californicus*, was seen soaring in the wind currents at the low cliffs on the north end of the island.—WILLIAM H. MARSHALL, *University of Minnesota, St. Paul 1, Minnesota.*

Ocean Vessels and the Distribution of Birds.—On November 14, 1950, the S. S. Steel Surveyor of the Isthminan Steamship Company left Colombo, Ceylon, for the United States. I was a passenger, returning from Calcutta, India. The vessel was a C3 type, Dry Cargo, with a loaded tonnage of 18,000 tons. Her length was 492 feet overall and beam was 69.2 feet. She made an average of 17 knots an hour.

We cleared the port of Colombo at five a. m. and about one hour later a wind squall arose from the mainland of Ceylon and engulfed the ship. The disturbance was of a short duration and when the skies cleared, Captain Burton Green pointed out to me four crows on the ship. They were the Common House Crow, *Corvus splendens*, and were perched on the foremast of the ship. This species is a common form of India and Ceylon. This crow is found always in the company of man. These four birds apparently had been blown from the mainland and had taken refuge upon our cargo ship. As we were well out to sea the birds remained aboard, making themselves at home, and devouring the food and water offered them. For six days the crows remained aboard; on November 18, the ship came within eight miles of Cape Guardafui, Somaliland, Africa, and the Socotra Islands. The sea was smooth and land clearly visible. The crows left the ship and flew towards the Cape. Through binoculars it appeared that they made a safe landing upon the rugged cliffs. The crows had been transported about 3,000 miles over the Indian Ocean.

On the afternoon of November 19, while the ship was in the Gulf of Aden, a Hoopoe, *Upupa epops*, in pursuit of a dragon fly terminated its flight on the radar mast of the ship. For five days this bird alternately circled the ship and rested upon its deck. I did not observe the bird feeding during its sojourn aboard. At Suez where we dropped anchor prior to entering the Suez Canal, the Hoopoe flew to the African shore. Its flight appeared to be strong despite its lack of finding food aboard. I had observed Hoopoes upon the Indian lawns, in groups of three to five, as they probed the soil in search of insects. On the ship the bird appeared out of its usual habitat, although it seemed to enjoy circling the ship and flying alongside as the ship moved at 19 knots an hour.

On the morning of November 20, as we entered the Red Sea through the Straights of Bab El Mandeb, a White Wagtail, *Motacilla alba*, came aboard; later, this bird was joined by another. These birds walked the afterdeck, incessantly wagging their tails. Their food consisted of a green aphid which they pursued on the deck of the ship. The vessel was homeward bound and the seamen were busily engaged in the activities of preparing the ship for the home port. However, their activities did not discourage the Wagtails for the birds flew among the working crewmen. At Port Said the Wagtails left the ship. They had ridden the ship the entire length of the Red Sea and the Suez Canal and had probably flown ashore to some part of Egypt.

These observations are examples of one method by which organisms may be introduced into different parts of the world.—MALCOLM DAVIS, *The National Zoological Park, Washington, D. C.*

NOTES AND NEWS

The Committee on Biography will welcome heartily the preparation of obituaries by any member. To prevent duplication of effort, please send to A. W. Schorger, 168 North Prospect Avenue, Madison 5, Wisconsin, the name of the deceased member for whom the obituary will be prepared.

The Editor wishes to extend his sincere thanks to all those who have aided in producing Volume 68 of 'THE AUK.' Many have aided by reading manuscripts in their particular fields of interest. John Emlen, S. Charles Kendeigh, and Robert W. Storer, members of the Editorial Committee, have done much of the first-reading of manuscripts submitted for publication. Robert W. Storer prepared the Index to Volume 68.

Appreciation of the colored plate and the increased use of black and white plates has been expressed by a host of readers. We take this opportunity to pass along this appreciation to all who contributed funds. The next colored plate will be in the January, 1952, issue and will be of the Cahow, painted by Roger Tory Peterson.

In June, 1951, the first five grants for ornithological research were made from the income of the Frank M. Chapman Memorial Fund. The amount distributed totaled $1950.00; the recipients were as follows:

RICHARD B. FISCHER, Cornell University. A study, based upon banded birds, of the reproductive behavior of the Chimney Swift in central New York State.

BYRON E. HARRELL, University of Minnesota. Faunal and ecological investigations of bird life in southern Tamaulipas, Mexico.

OWEN A. KNORR, Colorado College. Life history studies on the Northern Black Swift in the Rocky Mountains.

MRS. ROBERT SCHULTZ, University of Washington. Continuation of a study of the life history of the Glaucous-winged Gull.

DAVID K. WETHERBEE, Clark University. Research on the pterylosis of North American birds.

Additional grants from the Chapman Memorial Fund may be made in the spring of 1952. In general, the needs of student investigators will be given preference over those of candidates already possessing widely recognized scientific prestige. Applicants should clearly state their problem and their qualifications and should be sponsored by one or more of their professors. Requests should be addressed to the Frank M. Chapman Memorial Committee, American Museum of Natural History, Central Park West at 79th, New York 24, New York. They should be received not later than January 31, 1952, in order that decisions may be made well in advance of the summer vacation period.

RECENT LITERATURE

Sexual Behavior in Penguins.—L. E. Richdale. (University of Kansas Press, Lawrence), i–xi, 1–316, 22 photographs, 5 graphs, 1 map, 57 tables, 6 appendices, literature cited, index, 1951. Price, $5.00.—This book deals with the relations between members of the same or opposite sexes that involve actions of both aggressive and "love-habit" nature. The study was carried over ten seasons, 1936 to 1946, of intensive field work on the Otago Peninsula in New Zealand. Special attention is given to the Yellow-eyed Penguin, *Megadyptes antipodes*, but reference is also paid to corresponding behavior in other penguins and in other birds so that the discussions of concepts have general application. Altogether, some 292 matings were observed between 88 male and 96 female Yellow-eyed Penguins. All birds were banded, and the home-made bands bore numbers sufficiently large to be read through a telescope as far as 120 feet away.

Both love-habits and aggressive behavior have value in social relations, in pair-formation, and in family affairs. Aggressive behavior also functions against predators and as warning. Love-habits are of various sorts which are designated as: salute, sheepish look, throb, shake, excited shake, open-yell, half trumpet, welcome, full trumpet, arms act, mutual preen, kiss-preen, bowing, and ecstatic. Aggressive behavior is described as tête, open yell, sheepish look, glare, and physical force. Substitute activities occur commonly as the result of antagonistic drives, lack of proper stimulation for the reaction to be expected, exhaustion of normal reactions, or physical inability to respond with the proper behavior. Each type of behavior has a special significance in the life of the bird, and the description, illustration, and analysis of the circumstances and the sequences in which these various behavior-traits occur are the essence of this book.

Pair-formation may occur at any time of the year in the Yellow-eyed Penguin but most commonly in the winter at the peak of the sexual phase. The birds appear to have a definite and continuing recognition of each other as individuals, and there is immediate recognition of sex without "trial and error." The adornments on the head and neck have no function relative to love-habits but may be useful at sea in enabling the bird to recognize its own species. Love-habits keep the birds mutually stimulated, but copulation occurs when the female is ready and not as the direct result of any special stimulation by the male. The gonadal development of the female and the laying date appear also not to be influenced by the male. Copulation may occur at intervals during the pre-egg stage but ceases a day or two before the eggs are laid. The female is receptive of coition only at intervals, but the male is sexually ready at all times. Continuing love-habits hold the sexes together throughout the nesting period. Love-habits have a further function in bringing unmated birds together to get acquainted, which may ultimately result in pairing. The initiative for pairing may come from either sex. Some individuals appear to have an affinity for each other that affects pairing. Affinity between an unmated bird and one of a pair may lead to "divorce" of the pair. Other causes of divorce are the dominance that may be exerted by one bird, usually an unmated male, over a pair and the prolonged absence of one member of a pair.

Fifty-five per cent of matings remain intact in the succeeding season, 33 per cent break up because of death or disappearance of one or both birds, and 12 per cent of the birds separate and remate with other individuals. One pair remained intact for 11 seasons. Probably remating actually occurs each season, even in pairs that remain intact, but this is facilitated by return of birds to the old nesting-site, recog-

nition of each other, and personal attachment. Owing to a surplus of males, there is competition and intrasexual selection among the males for mates. Females seldom remain unmated, and there may be some competition for particular mates also among the females. The normal breeding age is three years, but 22.8 per cent of recovered two-year olds are known to have bred.

There is very little evidence of social hierarchy beyond the low level of "supersedence" in the loose colonial groups of penguins. Some degree of dominance is involved, however, when one male acquires the mate of another over the other's objection. Territory is expressed in the defense of the actual or potential nest-site, the nest and its contents, chicks out of the nest, and the mate. The male usually does the fighting for territory, although the female helps in some cases. Both sexes fight among themselves over sex-partners and together against enemies. Sexual fighting largely ceases once the eggs have been laid and does not begin again until the departure of the young. It may occur at any other time of the year when the birds are ashore.

"Unemployed" birds, so-called, are those without eggs or chicks at the time mated pairs have them. The causes of unemployment among various species of birds are immaturity, unbalanced sex-ratio, and loss of mate, eggs, or young. Non-breeding birds constituted 35 per cent of the total population over a period of years. Unemployed birds are tolerated by the breeding birds as long as they do not infringe on territories. Love-habits occur among these birds at all times of year, and "trumpeting" is far more prevalent with them than with the nesting group. The presence and competition of these unemployed but potentially breeding birds in the nesting community probably raises the level of mating efficiency and is of advantage to the species as a whole.

Incubation of the two eggs averages 42 days and is performed alternately by each sex. Attentive periods vary from one to five days but average about 1.8 days. There is a ceremony of nest-relief. As a rule both eggs hatch on the same day. The chicks are continuously brooded by both parents for the first two weeks but less regularly thereafter and not at all after the fourth week. One or the other parent guards the young during the day until the end of the sixth week but after that only at night. The second chick at one nest entered the sea approximately four months after hatching. Both parents share equally in watching and feeding the young. The chicks are fed at least once daily. There is no regular starvation period to induce grown young to leave for the sea. Both parent penguins and chicks recognize each other by sight or hearing. The Yellow-eyed Penguin does not form crèches, and the author suggests that in the communistic groups of young and old in some other species each parent may possibly feed only its own young and that surplus adults may be "unemployed" individuals.

In February, after nesting is over and the chicks have departed, there are about 23 days when the adults feed excessively and become very fat. This immediately precedes molting. The duration of the molt is usually 24 days, during which time the birds remain ashore and do not feed. Since most breeding birds begin their molt in March, this is the time of year when body weights are highest. Unemployed birds ordinarily molt earlier, occasionally as early as January. Molting is over in all birds by May. Body weight during this non-feeding period drops from 17.1 to 9.4 lbs. However, normal weight is regained by June and reaches another peak in August. There is special interest that in this resident penguin there is the same development of heavy deposits of fat prior to nesting that occurs in some passerine species just before migration. From late August to early October there is a second

fasting period as the adults are occupied with mating, nesting, and egg-laying. During incubation, as the birds take regular turns at feeding, there is gradual recovery of weight. Hatching occurs in November and body weight of the adults is generally maintained during the period of care of the young. During most of the year the male is heavier than the female. There is, however, no sure way of distinguishing sex by weight or by other measurements due to overlap in characteristics, although sex can be determined by examining the vent just after the eggs are laid.

A long summary would be necessary to give adequate justice to the great mass of carefully detailed information that is made available in this book. There is evidence on every page that the author is keen in his observations, penetrating in his analysis, and conversant with related information on other species. The result is not only a thorough treatise of sexual behavior in one species, but also a useful summary for penguins as a group and a fundamental discussion applicable to birds in general with which any student of this phase of ornitholgy needs to be familiar.

The author is very precise in his use of terms and gives each a very definite meaning. He follows J. S. Huxley in using "love-habits" instead of "courtship" since such behavior extends throughout the year and is not necessarily confined to behavior preparatory to pair-formation or coition as courtship may imply (p. 45). Elsewhere however (p. 6), he states that "in this paper 'courtship' is synonymous with love-habits." Not everyone will agree with all his usages of terms. The reviewer does not believe it necessary to distinguish between "territory" and "property-rights." This is done on the assumption that territory is a fixed, permanently located "defended area" and does not apply to the defense of a bird's mate, potential mate, or offspring when not on the immediate nest-area (p. 152). The term, territory, has, however, been used in the latter sense (D. W. Jenkins, Auk, 61: 30–47, 1944), and there is no good reason why it should not continue to be so used. The term "non-breeding," has been used commonly by other students in nearly the same sense that the author uses "unemployed" and would seem to be sufficiently inclusive. The reason given for the new term is to include those birds which, because of loss of eggs or chicks, are not actually nesting at the time of observation as well as the "true non-breeding birds" that do not nest at all during the season (pp. 7, 215). Perhaps "divorce" is an anthropomorphism and not a good term when applied to birds. "Separation" would have been better. Divorce in human affairs involves legal action that formally recognizes that a separation has taken place. Likewise the author makes the term include the mating of one of the pair with a third individual (p. 7). This is something quite different and does not in other species necessarily follow separation. These are, however, minor points and the book is recommended to the attention of all.—S. CHARLES KENDEIGH.

The Learning Abilities of Birds.—W. H. Thorpe. Ibis, 93 (1): 1–52; and 93 (2): 252–296, 1951. This is a comprehensive paper presenting the modern approach to the study of animal behavior, based on the work of Craig, Heinroth, Lorenz, and Tinbergen. In the introduction the nature of inborn behavior is discussed. The automatic response of an animal to its environment may be reflex, a kinesis, or a taxis. The first is defined as a "quick, automatic response of a single organ or organ system . . . to a simple stimulus." A kinesis is an undirected locomotory reaction, while a taxis is a directed reaction. In instinctive behavior "inborn stereotyped movements and patterns of action play a major part; . . . they are usually associated with an inherited disposition to recognize, and pay particular attention to, certain environmental situations which set off this instinctive behaviour and which are now generally known as 'releasers,' "(p. 3). Dr. Thorpe uses this last term in a

wide sense for he extends it "to cover all environmental patterns which govern the emergence of instinctive actions, such as the appearance of the normal territory, or the kind of landscape which constitutes the normal environment of the species," (p. 8).

Learning is defined as "adaptive change in individual behaviour as a result of experience" (p. 8). Eight main types of learning are discussed: habituation, conditioning, trial-and-error, insight learning, imitation, imprinting, "some learning abilities of doubtful significance (individual recognition, tameness, 'alternative' nesting associations)", and memory.

Let us consider learning with the newly-hatched bird. Habituation, imprinting, and trial-and-error are the first categories to function. Habituation is "the simplest kind of learning . . . a simple learning *not* to respond to stimuli which tend to be without significance in the life of the organism," (p. 10). Thus the altricial nestling learns to restrict its begging responses to its parents. When fledged, habituation enables it to ignore stimuli that are unimportant to it. Habituation, however, does not blunt a bird's instinctive response to the appearance of a primary enemy. Imprinting is important with many precocial birds, a learning of the parent and brothers-and-sisters (normally its own species) to which later social and sexual responses will be made. It is by trial-and-error that the young bird learns what is edible, that water is good for drinking and bathing, and, after it starts to fly, how to land.

Social facilitation (treated under "imitation") is important in families of precocial birds in the matter of adjusting to the environment. It is also the method by which young birds learn from parents and associates to recognize certain enemies. "Individual recognition" of brothers and sisters and of parents often comes within a week or two with precocial young.

Memory of places is excellent in birds, as is memory of individuals with certain species. Memory for occasions of extreme fright and for enemies may be long. Under "conditioning" Dr. Thorpe includes only the "classical conditioned reflex" and he rightly points out "how artificial and isolated" this is (p. 14). Evidence for true imitation is slight. Twenty-two pages are devoted to insight learning under eight sub-headings, of which perhaps the most important are "territorial learning as latent learning," "tool using," and a detailed discussion of the "number concept," in which Otto Koehler's experiments are summarized. "Two pre-linguistic faculties —simultaneous, and successive unnamed number sense—have been demonstrated in some species of birds." Experiments on human beings indicate that "the limit of achievement is of the same order as that shown by birds." "Very many ideas come to us in wordless form, as they must do with birds and other animals; the essential difference is that we can recount ideas afterwards in words and animals cannot," (p. 48).

It is not clear to me how Dr. Thorpe classifies that fundamental type of learning which might be called the positive side of habituation, as when domestic fowl come running at their owner's call, or baby Wood Ducks, *Aix sponsa*, learn that a certain clucking of their foster mother hen means food. This used to be considered a matter of association, and more recently has been called conditioning, using the term in a wider sense than that employed by Pavlov.

A very interesting section is that on "Song acquisition as imprinting." As is well known, in some species with simple songs the song is inborn, but with others it has to be learned. If such a bird does not hear its own species, it will adopt songs of other species, but once it hears the proper song it will quickly adopt it, according to Heinroth. A Danish ornithologist, H. Paulsen, has found that Chaffinches, *Fringilla*

coelebs, learn their song in the early spring of their second year. Dr. Thorpe deplores the lack of detailed observations on this subject of the acquisition of song.

Nowhere does Dr. Thorpe clearly define imprinting. He says: (1) it is "extraordinarily stable;" (2) it is most evident during "a very definite and brief period of the individual life;" (3) it is "characteristic of the first hours or days of life;" and (4) it is "a learning of the broad characteristics of the species," (p. 260). Tinbergen (1942: 83) calls it "an extreme case of learning ability confined to a critical period," and this better fits a broad view, for this critical period would come in the second and third weeks with some altricial nestlings for Dr. Thorpe's fourth point, and many months after hatching if learning of territory and song are to be included under imprinting, as is suggested in the present paper. As to the first point, my experiences at the Delta Waterfowl Research Station in Manitoba with ducklings (incidentally not one of the 27 newly-hatched individuals of eight species displayed fear of a human being) showed that "imprinting" could be easily lost. Dr. Thorpe states that the subject of imprinting "needs, and would repay, full and precise experimental investigation almost more than any other aspect of animal behaviour," (p. 266).

The paper concludes with a ten-page bibliography. Dr. Thorpe has presented a most valuable review article on this important subject, organized and presented in masterly fashion. It is an important contribution to the study of bird behavior and one which will be particularly enlightening to us on this side of the Atlantic.—MARGARET M. NICE.

Vertebrate Ecology of Arno Atoll, Marshall Islands.—Joe T. Marshall, Jr. Scientific Investigation in Micronesia, Pacific Science Board, National Research Council, Washington, D. C., ii–38 pp., 4 figs. (mimeographed) November, 1950.—Since World War II, American biologists have been conducting numerous investigations in the Pacific, and the Pacific Science Board, ably coordinated by Mr. Harold J. Coolidge, has been one of the leading organizations at work there. The author of this report, Joe T. Marshall, Jr., was well chosen for this project in Micronesia because of hi. previous field experience there in World War II, when he observed and collected vertebrates in the Mariana and Palau islands (for birds see Condor, 51: 200–221. 1949).

Biologists have long been intrigued by the terrestrial organisms living on the dot-like, oceanic islands of Micronesia, knowing that for animals to reach these islands they must either cross or be carried across a vast expanse of salt water. Arno Atoll is located in the extreme eastern part of Micronesia, and its impoverished land fauna reflects this isolation. Marshall, who worked there from early June to early September, 1950, recorded nine kinds of reptiles, seven kinds of mammals and fourteen kinds of birds. He obtained representative specimens and both external and internal parasties from these animals. References to birds in his report are included under headings as follows: "Accounts of Species," "Time of Activity," "Seasonal Behavior," and "General Remarks on Carrying Capacity." A discussion is given of the habits, foods, and population densities of five sea birds, five shore birds, one fresh water bird, two native land birds and the domestic chicken. Of special interest are the comments on the Micronesian Pigeon, *Ducula oceanica*. Marshall's observations indicate that this large bird is present in fair numbers and is not near extinction in the Marshall Islands, as previously supposed. Bird skins and skeletons have been deposited in the United States National Museum and in the collection of the Department of Zoology, University of Arizona. It is hoped that Dr. Marshall will publish (as opposed to mimeograph) his account of the birds; it is an important contribution to Pacific biology.—ROLLIN H. BAKER.

Rocky Mountain Naturalists.—Joseph Ewan. (Univ. Denver Press, Denver, Colo.). xiv + 358 pp., 9 illus., December 19, 1950. Price $5.00.—An exhaustive compendium commencing with an historical preview of avenues of penetration to the Timpanogos [Utah] and the North Pacific. The book is then divided into two sections. The first consists of detailed biographies with portraits of nine leading naturalists: Edwin James, John Charles Fremont, Charles Christopher Parry, Edward Lee Greene, Thomas Conrad Porter, Harry Norton Patterson, Marcus Eugene Jones, Eugene Penard, and Theodore Dru Alison Cockerell, in the order listed and occupying 103 pages. Explanatory notes and bibliography accompany this section. The second portion is a roster in biographical dictionary form of 798 natural history collectors. The entries are both biographical and bibliographical thus indicating not only who the individuals were or are, but when and where they lived or live, what they may have done to advance the biological sciences, their principal publications and sources of information. The length of the entry is not an indication of the true importance of the person for should he be well known and included in other books of reference, Ewan's remarks are brief; obscure persons in contrast are treated more fully as original information is given. The period covered is 1682 to 1932.

The author being a botanist, the book leans heavily in that direction, and Colorado, his former place of residence, is the favored state of the region. The roster should prove of value to ornithologists not only for identifying bird collectors and students but also in tracing areas where collections were made and determining where type specimens may have been collectbd.

In gathering his material, Ewan was necessarily dependent largely upon the literature and, it being a tremendous task to cover all fields, omissions are made in the write-ups of several people, at least in the Utah area with which the reviewer is familiar. This may be partly because of reluctance to duplicate material contained elsewhere. As a consequence a true picture of the individual's contribution is sometimes not presented. This book will serve as an invaluable reference and regional guide.—William H. Behle.

The Life of Vertebrates.—J. Z. Young (Oxford Univ. Press, New York), pp. xv + 767, 497 figs. December 7, 1950.—This book is an attempt to portray the organization and evolution of life in the different classes of vertebrates, as well as in the protochordates. Anatomy, embryology, physiology, ecology, psychology, and paleontology are discussed in varying degree. The result is a well-rounded text in vertebrate zoology.

Of special interest to ornithologists is the 100-page section on birds. In many ways this section is admirably set up. It includes consideration of most aspects of bird life, although very briefly in some instances, and is particularly modern and complete in its treatment of flight, of the nervous system, and of certain features of behavior. If all aspects of feathered life were handled as well as these, the part on birds would make a good textbook of ornithology, which I think is one of the most urgent needs in this field today. We have many "bird books," for field identification, for distribution, for display of photographs, and for "interesting" items about birds, but we have not one, up-to-date general work, in any language, on the biology of birds, with the possible exception of the French "Oiseaux: traité de Zoologie" reviewed on page 537 of this number of 'The Auk.'

The author was no doubt limited by space as to the details he could include, and he was, of course, writing a general book on vertebrates, but some deficiencies in the avian section should be pointed out. Food habits are discussed only in relation to

adaptive evolution in Darwin's finches, and to bill structure in general, the palatal grouping of primitive birds is retained, despite the independent findings of Hofer in Vienna (Acta Zool. Internat'l. Tidskr. Zool., 30: 209–248, 1949) and McDowell in the United States (Auk, 65 (4): 520–549, 1948) that this grouping is largely untenable. Under "the stimulus to migration" one finds mention only of the work of Rowan and this is not listed in the bibliography for the chapters on birds, which incidentally is woefully inadequate. It has only 18 titles, and these are compilations, not original papers.

Nesting, parental care, function of sounds produced, structure and function of the respiratory system, and social parasitism are other subjects that would have benefited by more complete treatment and by more use of papers published in the last 10 to 15 years.—H. I. Fisher.

Oiseaux: Traité de Zoologie.—Ed. P.-P. Grassé. (Masson et Cie., Paris), Vol. 15: 1–1164, 1950. Price, 6000 francs. This book is a collaborative effort. The contributors and chapter headings are: N. Mayaud, skin and other external features, longevity, biology of reproduction, alimentation, vocal and other sounds, behaviour and social life; A. Portmann, skeleton, nervous system, sense organs, circulation of the blood, respiratory system, digestive tract, body temperature and homothermy, postembryonic development; E. Oehmichen, muscular system, flight, terrestial and aqueous locomotion; A. Rochon-Duvigneaud, eyes and vision; P.-P. Grassé, uropygial gland, organization of bird societies; J. Benoit, endocrine glands, urogenital organs, reproduction—sexual characters and hormones determining the seasonal sexual cycle; R. Matthey, chromosomes; J. Pasteels, embryonic development; F. Bourlière, ecology, physiology of migration; J. Piveteau, origin and evolution of birds; J. Berlioz, systematics, geographic distribution, general aspects and origin of migration; É. Letard, origin of domestic birds.

The various phases of ornithology are treated as extensively as is permissible for a single handy volume, and the book can be read with profit to obtain a broad grasp of the science. It is to be expected that some of the greatest differences of opinion will arise on classification. J. Berlioz, while granting the close relationship of the Coraciiformes and Caprimulgiformes to the Strigiformes, deplores the separation of the latter from the Accipitriformes (Falconiformes) as is done in some modern classifications.

The volume is similar in the arrangement of subjects to Stresemann's 'Aves' (1934) and offers the advantage of having the information brought up to date. The illustrations are numerous and excellent. Greater care could have been exercised in reading the proof. Even a reader with a good command of English will be puzzled by the following reference (p. 756): 'Pawing [pairing] responses of freelwing [free-living] valley Quail. . . .'—A. W. Schorger.

A Bibliography of the Published Writings of William Brewster.—Charles Foster Batchelder. Mem. Nutt. Orn. Club., No. 10: 1–54. February, 1951. Price $2.50.—In the very brief introduction, Brewster is credited with doing more than any of his contemporaries to raise the standards in all fields of ornithology. His career and published writings came at a time when American ornithology was developing rapidly. It is pleasing, therefore, to see made available, in careful, briefly annotated style, this bibliography. There is an index to "technical names introduced by William Brewster."—H. I. F.

Bonner Zoologische Beiträge.—Volume 1, Number 1 of this journal appeared in August, 1950; Numbers 2 to 4 were published in March, 1951. It is published by

the Zoologisches Forschungsinstitut and the Museum Alexander Koenig, Bonn (Dr. Adolf von Jordans and Dr. Heinrich Wolf) under the editorship of Dr. Günther Niethammer.

Although it is a general journal, covering the field of zoology, ornithologists will find much to interest them. This first volume contains papers on birds by H. Mildenberger, A. Hoffman, H. E. Wolters, P. A. Clancey, E. Stresemann, L. v. Boxberger, B. Rensch, F. Frank, K. Steinparz, and E. Schüz, dealing with many aspects of distribution, natural history, flight, taxonomy, and anatomy (see titles listed under above authors for more detailed information).—H. I. F.

Adams, Lowell. 1951. Confidence limits for the Petersen or Lincoln index used in animal population studies. Journ. Wildl. Manag., **15** (1): 13–19.—Essentially a re-write of an earlier paper by Clopper and Pearson.—J. J. H.

Alexander, W. B. 1951. The index of heron population, 1950. Brit. Birds, **44** (4): 123–126.—Nesting populations of *Ardea cinerea* in the British Isles increased 14 per cent in 1950 over 1949; a chart shows the steady increase in the last three years after the very severe winter of 1946–47.—M. M. N.

Armstrong, Edward. 1951. Discharge of oily fluid by young Fulmars (A supplementary note to "Field studies on the Fulmar," by Eric Duffey). Ibis, **93** (2): 245–251.—Suggests that the squirting of oily fluid by young Fulmars is a defense mechanism chiefly against winged predators.

Armstrong, Edward. 1951. The significance of a dark ventral surface in certain birds. Ibis, **93** (2): 314–315.—A reply to a note by Meinertzhagen in Ibis, 93 (1): 140. The examples cited by Meinertzhagen do not appear to be in conflict with the author's theory that "the tendency to evolve dark underparts is correlated with display behaviour in which another bird is sufficiently near for the adornments to have a stimulating effect upon it."

Avelado, Ramón, and Hno. Ginés. 1949. Ave Nueva para la Ciencia. Novedades Científicas, Contrib. Oc. Mus. Hist. Nat. La Salle (Caracas) Ser. Zool., No. 1: 1–3.—*Myrmeciza laemosticta venezuelae*, new subsp. from Cerro Ayapa, Estado Zulia, Venezuela.

Aveledo, Ramón, and Hno. Ginés. 1951. Seis Aves Nuevas para la Avifauna Venezolana. Novedades Científicas, Contrib. Oc. Mus. Hist. Nat. La Salle (Caracas) Ser. Zool., No. 4: 1–5.

Bagenal, T. B. 1951. Birds of the North Atlantic and Newfoundland Banks in July and August, 1950. Brit. Birds, **44** (6): 187–195.

Bailey, Alfred M. 1951. Notes on the birds of Midway and Wake Islands. Wilson Bull., **63** (1): 35–37, 1 photo.

Barbour, Roger W. 1951. Observations on the fall and winter food of Bobwhite Quail in Kentucky. Journ. Wildl. Manag., **15** (1): 108.—In 331 stomachs of *Colinus virginianus*, *Lespedeza stipulacea* ranked 25 per cent by volume, *Ambrosia artemesiifolia* 17 per cent, and corn, *Zea mays*, 9 per cent.

Benson, C. W. 1950. The occurrence of the European Shoveller *Spatula clypeata* (Linnaeus) in South Africa. Ostrich, **21**: 56–57.—With remarks on loss of male plumage in tropical waterfowl.

Benson, C. W. 1950. Some notes on the Spotted Forest Thrush, *Turdus fischeri*. Ostrich, **21**: 58–61.—*Turdus fischeri belcheri*, new subspecies from near Blantyre, southern Nyasaland.

Benson, C. W. 1951. Breeding and other notes from Nyasaland and the Lundazi District of Northern Rhodesia. Bull. Mus. Comp. Zoöl., **106** (2): 69–114.—An

annotated list of 165 species of birds collected and observed. Special reference is made to breeding seasons and nesting habits, and nests and eggs of *Pseudoalcippe stierlingi stictigula*, *Tricholaema diadematum frontatum*, *Parus rufiventris masukuensis*, and *Nectarinia johnstoni salvadorii* are described for the first time.

BENTON, ALLEN H. 1951. Effects on wildlife of DDT used for control of Dutch elm disease. Journ. Wildl. Manag., 15 (1): 20–27.—Following application of 1.5–3 lbs. of DDT, certain species decreased 22 per cent on study area, and nestling mortality increased. Spraying before April 15 (in New Jersey) is recommended.

BERGER, ANDREW J. 1951. The Cowbird and certain host species in Michigan. Wilson Bull., 63 (1): 26–34, 3 tables.—A study of the egg-laying habits of the Cowbird, *Molothrus ater*, and its effect on the approximately 20 species of hosts observed.

BERGSTROM, E. ALEXANDER. 1951. The South Windsor Bank Swallow colony. Bird-Banding, 22 (2): 54–63.—Six years of banding *Riparia riparia* in one colony. A table is given of return and recovery records for swallows in North America and Great Britain; percentages range from 0.5 to 11.5; the last being found in the present study.—M. M. N.

BOND, GORMAN M., AND ROBERT E. STEWART. 1951. A new Swamp Sparrow from the Maryland coastal plain. Wilson Bull., 63 (1): 38–40.—*Melospiza georgiana nigrescens* new subspecies (Nanticoke R. marshes, opp. Vienna, Wicomico Co., Maryland).

BORELL, A. E. 1951. Russian olive as a wildlife food. Journ. Wildl. Manag., 15 (1): 109–110.—Some 33 species of birds feed on *Elaeagnus augustifolia* in western United States.

BRITISH ORNITHOLOGISTS UNION. 1951. Twenty-third report of the subcommittee on the Nomenclature and Records of the Occurrence of Rare Birds in the British Isles and on certain necessary changes in the Nomenclature of the B. O. U. List of British Birds. Ibis, 93 (2): 297–298.—*Sitta europaeus caesia* Wolf is accepted as the race occurring in the British Isles; *Tringa totanus britannicus* Mathews is accepted as the breeding race in the British Isles; the record of *Larus argentatus heuglini* Bree is accepted. The records for *Emberiza citrinella citrinella* Linnaeus, *Lanius excubitor melanopterus* Brehm, and *Anas acuta tzitzihoa* Vieillot are rejected. The following recently proposed subspecies were not accepted:—*Charadrius hiaticula harrisoni* Clancey; *Saxicola rubetra hesperophila* Clancey; *Anthus trivialis salomonseni* Clancey.—J. L. PETERS.

BUSS, IRVEN O., ROLAND K. MEYER, AND CYRIL KABAT. 1951. Wisconsin pheasant reproduction studies based on ovulated follicle technique. Journ. Wildl. Manag., 15 (1): 32–46.—Date of first egg can be learned from ovarian examination of *Phasianus colchicus*. Little variation in date of first egg was noted between years (perhaps implying day-length as controlling factor), but date of incubation did vary annually. Relatively high frequencies of dropped eggs are implied. On two nearby areas, marked variation occurred each year in mean date of hatching, average brood size, broodless hens, and young per adult, apparently as result of differences in range conditions.—J. J. H.

CAMPBELL, BRUCE. 1951. Unusual features of the 1951 breeding season. Brit. Birds, 44 (6): 211.—Much of March and April was abnormally cold and wet, and breeding in Oxfordshire seems to have suffered as follows: long building periods, delays in egg dates, small clutch sizes, long "incubation" and nestling periods, unhatched eggs, high mortality among young, and enforced habitat changes due to flooding.—M. M. N.

CHRISTIAN, JOHN J. 1951. The mammals of the Mazinaw Lake region of Ontario; their reproduction and population dynamics. Ann. Carnegie Mus., **31**: 339–386.—Contains lists of breeding birds of several carefully described habitats.

CLANCEY, P. A. 1950. Comments on the indigenous races of *Delichon urbica* (L.) occurring in Europe and North Africa. Bonner Zool. Beitr., **1** (1): 39–42.—Recognizes four races in Europe and North Africa—*D. u. urbica*, *D. u. fenestrarum*, *D. u. meridionalis*, and perhaps a new race, unnamed, from Italy.

COBURN, DON R., DAVID W. METZLER, AND RAY TREICHLER. 1951. A study of absorption and retention of lead in wild waterfowl in relation to clinical evidence of lead poisoning. Journ. Wildl. Manag., **15** (2): 186–192.—Critical daily dosage in adult *Anas platyrhynchos* was 6–8 mg./kg. Diagnostic clinical symptoms are established for two dosing levels and relative survival times are set forth. Skeleton or liver or soft tissues are satisfactory as field samples for chemical analysis of lead poisoning.

COHEN, EDWIN. 1951. Feeding of juvenile Goldfinch by another juvenile. Brit. Birds, **44** (5): 174.—Juvenile *Carduelis carduelis* feeding bird, apparently of second brood, August 4, 1950.

COTT, HUGH B. 1951. The protective adaptations of birds' eggs, with special reference to relative palatability. Bull. Brit. Orn. Club, **71** (4): 23–24.

CUNNINGHAM, J. M. 1951. The position of the Myna in 1950. Notornis, **4** (4): 66–67.—*Acridotheres tristis*. Additional information on distribution.

DARLINGTON, ARNOLD. 1951. The use of mobile observers in the study of patterns of migration. Brit. Birds, **44** (5): 152–157.—In the study of the migration of *Apus apus* in 1950, 57 cyclists were used. Three maps show flight lines of swifts traced along the Cam Valley.

DAVIS, JOHN. 1951. Notes on the nomenclature of the Brown Jay. Condor, **53**: 152–153.—Evidence in favor of recognizing two races of *Psilorhinus morio*. *P. m. morio* (Wagler) applies to the northern population, thus synonymizing *P. m. palliatus* van Rossem and restituting *P. m. fuliginosus* (Lesson) for the southern.

DAVIS, T. A. W. 1951. Distraction-display of Common Partridge. Brit. Birds, **44** (6): 209.—A parent *Perdix perdix* with half-grown young did not "feign injury," but ran away with wings dropped and body feathers puffed, in the meantime giving a rat-like squeak.—M. M. N.

DEIGNAN, H. G. 1951. The genus Cuculus in North America, a reconsideration. Condor, **53**: 154–155.—All three of the known examples are referable to *Cuculus saturatus horsfieldi* Moore rather than *C. c. bakeri* Hartert as now indicated in the A. O. U. check-list.

DICKINSON, J. C. 1951. A twelve-year-old Sooty Tern in Arkansas. Bird-Banding, **22** (2): 79.—A *Sterna fuscata*, banded as an immature on June 23, 1938, in the Dry Tortugas, Florida, was found dead in Arkansas on September 4, 1950.

DUFFY, ERIC. 1951. Field studies on the Fulmar *Fulmarus glacialis*. Ibis, **93** (2): 237–245.—In July, 1949, the author visited Fair Isle for two weeks of intensive study of Fulmars. Three pairs were marked by squirting the adult birds with dye. Brooding periods by individual parents are irregular, and the sexes do not share in this duty equally. Feeding is also irregular. Chicks spit oil at any intruder, including flying birds, within a radius of two or three feet and up to nearly the third week this includes the parents. During the early weeks of the chick's life it does not beg for food; instead the parent sidles up to the chick "cackling," then nibbles at the down on the head. Finally, the chick and the parent commence a sort of fencing with the bills, after which regurgitation takes place.—J. L. PETERS.

EGGELING, W. J. 1951. Ringing palaearctic waders and other birds on Lake Victoria. Ibis, **93** (2): 312–313.—The operations were conducted on the beaches at Entebbe, Uganda. A clap net was first used, but due to difficulties of operation, the author worked at night using a flashlight and net with great success.

EMERSON, K. C. 1951. A list of mallophaga from gallinaceous birds of North America. Journ. Wildl. Manag., **15** (2): 193–195.

EVANS, CHARLES D. 1951. A method of color marking young waterfowl. Journ. Wildl. Manag., **15** (1): 101–103.—Six dyes were injected into duck eggs (at dosages equal to 0.4—0.6 gr. per kg. egg weight) 2 to 11 days before hatching, permitting field identification of individual broods 16–30 days after hatching.

FERIANC, O. 1950. Dryobates syriacus balcanicus (GENGL. et STRES.) na Slovensku. Sylvia, **11–12** (2): 51–56, 2 figs., 1 map.—French summary.

FLEAY, DAVID. 1951. Trapping Lyre birds for "resettlement." Animal Kingdom, **54** (2): 51–58, 6 photos.

FRANK, FRITZ. 1950. Die Vögel von Opuk (Schwarzmeer-Gebiet). Bonner Zool. Beitr., **1** (2–4): 144–214, 2 maps, 1 photo.—General discussion of the region of Opuk on the Black Sea, with a section on migration there, and species accounts.

FRANKE, H. 1951. Von der Stimme der Türkentaube. Natur und Land, **37** (3): 48.

GIBB, JOHN AND CHRISTINA. 1951. Waxwings in the winter of 1949–50. Brit. Birds, **44** (5): 158–163.—A map is given to show the distribution of some 2,000 *Bombycilla garrulus* in the British Isles in the winter of 1949–50. It was estimated that these birds ate much more than their own weight in berries each day.—M. M. N.

GIBSON, J. A. 1951. The 1950 census of gannets (*Sula bassana*) on Ailsa Craig. Journ. Animal Ecol., **20**: 87.—From 1936 to 1942 and from 1947 to 1949, the size of the population fluctuated considerably around a mean of about 5400 pairs, but in 1950 there was an astounding increase to about 6500 pairs.

GLEGG, W. E. 1951. On seven eggs attributed to the Labrador Duck *Camptorhynchus labradorius*. Ibis, **93** (2): 305–306.—A duck's egg in the Rothchild collection labelled "Canard Labrador," which was acquired by Lord Rothschild when he purchased the Count Roedern oological collection in 1889, is believed to be either that of a Labrador Duck or a Black Duck, *Anas rubripes*. There are six eggs in the Dresden Museum (not examined by the author) attributed to the Labrador Duck, although proof of the correctness of the identification is lacking.—J. L. PETERS.

GOODBODY, IVAN M. 1951. Inland Passage of Black Terns [*Chlidonias niger*] in the spring of 1950. Brit. Birds, **44** (5): 170–173.

GRANT, C. H. B., AND C. W. MACKWORTH-PRAED. 1951. Notes on eastern African Birds. Bull. Brit. Orn. Club, **71** (3): 18–19.—*Apalis griseiceps chyulu* (van Someren) = *Apalis griseiceps* (Reichenow and Neumann); *Schoenicola brevirostris chyulu* (van Someren) = *Schoenicola brevirostris alexinae* (Heuglin); *Melocichla mentalis chyulu* (van Someren) = *Melocichla mentalis amauroura* (Pelzeln).

GRATER, RUSSELL K. 1951. Recent bird records from Mount Rainier National Park. Condor, **53**: 156–157.—Notes on 18 species previously unreported or constituting unusual observations.

GULLION, GORDON W. 1951. Birds of the southern Willamette Valley, Oregon. Condor, **53**: 129–149.—Discussion of the environment and an annotated list of 212 species.

GULLION, GORDON W. 1951. A new marker for waterfowl. Journ. Wildl. Manag.,

15 (2): 222–223.—"Vinylite" plastic, folded into 30 x 20 mm. pieces, was colored and pinned to large pinch of skin at base of skull.

HACHISUKA, MASAUJI, AND TATSUO UDAGAWA. 1950. Contributions to the ornithology of Formosa. Part I. Quart. Journ. Taiwan Mus., **3** (4): 187–280, 1 map.—Historical review; extensive annotated bibliography; discussion of the environment on the island; discussion of the birds by families; migration.—H. I. F.

HALE, JAMES B., AND ROBERT F. WENDT. 1951. Ruffed Grouse hatching dates in Wisconsin. Journ. Wildl. Manag., **15** (2): 195–199.—Of 69 broods sampled, hatching spread over nine weeks, but 31 of the broods hatched June 3–9, and 45 hatched May 27 to June 9. A lack of renesting is suggested.

HALLER, KARL W. 1951. Observations on some New Mexican birds. Condor, **53**: 155–156.—Eight species of uncommon or unusual occurrence recorded mostly from the vicinity of Albuquerque.

HAMERSTROM, F. N., JR., AND FRANCES HAMERSTROM. 1951. Food of young raptores on the Edwin S. George Reserve. Wilson Bull., **63** (1): 16–25, 1 photo.—An analysis of food brought by the parents to young Cooper's Hawks, Red-tailed Hawks, and Barred Owls.

HANN, C. 1951. Courtship feeding of Green Woodpecker in August. Brit. Birds, **44** (4): 134.—Adult female *Picus viridis* begging from male and being fed by him as both probed for ants.

HANSON, HAROLD C. 1951. Notes on the artificial propagation of Wood Duck. Journ. Wildl. Manag., **15** (1): 68–72.—Hatching and rearing problems with *Aix sponsa* are described. Adequate moisture is needed during incubation; screen wire floors reduce infections of *Salmonella* bacteria. Night lights help young get insectivorous food.

HARDY, FREDERICK C. 1951. Ruffed Grouse [*Bonasa umbellus*] nest predation by blacksnakes [*Elaphe obsoleta*]. Wilson Bull., **63** (1): 42–43, 1 photo.

HARRISON, TOM. 1951. Two additions to the Borneo list. Ibis, **93** (2): 311–312.—*Oenanthe oe. oenanthe* (specimen) and *Larus ridibundus* subsp? (sight record).

HAVERSCHMIDT, FR. 1951. Notes on the life history of *Picumnus minutissimus* in Surinam. Ibis, **93** (2): 196–200.—A nest-hole of this piculet was found before its completion. At that time two males and a female used the hole for roosting, but after some days of incubation the second male was no longer permitted to roost there. Incubation is believed to have been about 14 days and the fledging period 28 days. Only one young was reared; together with the parents, the three birds continued to roost in the nest cavity for 62 days.—J. L. PETERS.

HAVERSCHMIDT, FR. 1951. The Cattle Egret *Bubulcus i. ibis* in British Guiana. Ibis, **93** (2): 310–311.

HAVERSCHMIDT, FR. 1951. Notes on *Icterus nigrogularis* and *I. chrysocephalus* in Surinam. Wilson Bull., **63** (1): 45–47, 1 photo.

HINDE, R. A. 1951. *Lusciniola melanopogon*. Bull. Brit. Orn. Club, **71** (5): 30.—A reply to a criticism.

HINDWOOD, K. A., AND A. R. MCGILL. 1951. The 'Derra Derra' 1950 camp-out of the R. A. O. U. Emu, **50** (4): 217–238, pls. 20–27, 1 fig. (map).—An account of annual camp-out Oct. 27–Nov. 6, 1950, of the R. A. O. U. following the annual meeting. The site of the camp-out was at Derra Derra station, about 150 miles inland from the east coast of Australia and 300 miles north of Sydney. There is an annotated list of 144 species recorded during the period.

HOBBS, JOHN T. 1951. Distraction display of adult and diving of young Little Grebe. Brit. Birds, **44** (6): 207.—An adult *Podiceps ruficollis* churned through the water and flapped clumsily away at the approach of the writer; one young, a

day old, and two hatched that morning dived and swam three to four feet under water.

HOFFMANN, ALFRED. 1950. Der Indische Kuckuck (*Cuculus micropterus* Gould). Studien aus Peking und Nanking. Bonner Zool. Beitr., **1** (1): 21–30.—General notes.

HURRELL, H. G. 1951. The movements of swifts in summer. Brit. Birds, **44** (5): 146–152.—Report on 20,000 *Apus apus* watched in 1950 under auspices of the British Trust for Ornithology.

KEVE, A. 1948. Über die ornithologische Sammeltätigkeit im russischen Reich. Ann. Nat. Hist. Mus. Wien, **56**: 77–129.—Species accounts.

KLIMSTRA, W. D. 1951. Some factors affecting the growth and survival of multiflora rose as cover for quail in Davis County, Iowa. Journ. Wildl. Manag., **15** (2): 158–190.

KLUZ, ZDENĚK. 1950. Příspěvek k hnízdní biologii rorýse obecného evropského, Micropus apus apus (L.). Sylvia, **11–12** (2): 37–51, 5 tables, English summary.—Nest materials, arrival, eggs and breeding, hatching, weights and measurements, food, and parasites of the Swift.

KOENIG, O. 1951. Das Aktionssystem der Bartmeise (Panurus biarmicus L.). Österr. Zool. Zeitschr., **3** (1): 1–82, 3 sketches, 15 photos.—First part only.

LACK, DAVID AND ELIZABETH. 1951. Migration of insects and birds through a Pyrenean Pass. Journ. Animal Ecol., **20**: 63–67.—A spectacular migration of small passerine birds, pigeons, butterflies of several species, one species of dragonfly, and one species of syrphid fly through a pass at 7500 feet.

LOW, SETH. 1951. Cooperator participation for the 1950 bird banding year. Bird-Banding, **22** (2): 64–71.—List of banders with number of birds banded by each from May 1, 1949, through April 30, 1950.

MACDONALD, J. D. 1951. Kestrels at sea. Ibis, **93** (2): 308–309, 1 text fig.

MACDONALD, J. D., AND C. H. B. GRANT. 1951. On the author and reference of *Ardea lentiginosa*. Bull. Brit. Orn. Club, **70** (5): 30.—*Ardea lentiginosa* Rackett, in Pulteney's Cat. Bds. etc. of Dorsetshire, May 14, 1813, p. 14, antedates *Ardea lentiginosa* Montague, Suppl. Orn. Dict., June, 1813. Both descriptions based on the same specimen.—J. L. PETERS.

MACKWORTH-PRAED, C. W., AND C. H. B. GRANT. 1951. On the races of the Wheatear *Oenanthe oenanthe* (Linnaeus) occurring in eastern Africa. Ibis, **93** (2): 234–236, 1 text fig. (map).—Three races recognized: *O. o. oenanthe* (Linn.) of which *Saxicola rostrata* Hemprich and Ehrenberg, *Saxicola oenanthoides* Vigors, and *O. o. integer* Clancey are considered synonyms; *O. o. libanotica* Hemprich and Ehrenberg of which *O. o. argentea* Lönnberg, *O. o. nivea* Weigold, and *O. o. virago* Meinertzhagen are considered synonyms; and *O. o. leucorhoa* Gmelin, with *O. o. schiöleri* Salomonsen in synonymy.—J. L. Peters.

MADSEN, F. JENENIUS, AND R. SPÄRCK. 1950. On the feeding habits of the Southern Cormorant (*Phalacrocorax carbo sinensis* Shaw) in Denmark. Danish Rev. Game Biol., **1** (3): 45–76.—Stomachs and gullets of 365 birds were examined; 98 per cent of the food came from marine waters—herring 34, eel 22, viviparous blenny 22, and cod 10 per cent. The effect on commercial fishing is negligible. A record of Dutch Cormorant said to have been shot in Minnesota is quoted from Tåning (1944). Although I did not check this reference (it is omitted in the bibliography), I believe the report is in error.—J. J. HICKEY.

MADSEN, HOLGER. 1950. Studies on species of *Heterakis* (Nematodes) in birds. Danish Rev. Game Biol., **1** (3): 1–43.—Taxonomic analysis and review; list of some 80 host species of birds covers 10 orders from Rheiformes to Psittaciformes.

MARCHANT, S. 1951. Calls of some forest birds, pt. 1. Nigerian Field, **16** (2): 70–79.—Notes on various species of West African birds with particular attention to their voices.

MARIEN, DANIEL. 1951. Notes on some pheasants from southwestern Asia, with remarks on molt. Amer. Mus. Novit., No. 1518: 1–25.—Taxonomic notes on forms of the genera *Lerwa*, *Ammoperdix*, *Tetraogallus*, and *Pavo*, based chiefly on specimens in the Walter Koelz collection. In a discussion of wing and tail molt it is tentatively concluded that attempts to divide the Phasianidae into subfamilies solely on this basis will probably be unsatisfactory or incorrect for certain species.

MARSHALL, DAVID B. 1951. New bird records for western Nevada. Condor, **53**: 157–158.—Notes on 11 aquatic birds from the Lahontan Valley and Carson Sink area.

MASON, A. G. 1951. Aggressive display of the Corn-Crake. Brit. Birds, **44** (5): 163–166.—Eight photographs of a male *Crex crex* before a mirror; three postures were shown, but not in any definite order.

MCGILL, ARNOLD R. 1951. Proceedings of the Annual Congress of the R. A. O. U., Sydney, 1950. Emu, **50** (4): 240–250.

MCKENZIE, H. R. 1951. Breeding of Kokako [Blue-wattled Crow, *Callaeas cinerea wilsoni*]. Notornis, **4** (4): 70–76.—In Moumoukai ranges. First photographs taken of this rare species.

MEINERTZHAGEN [RICHARD]. 1951. Syrian Ostrich eggs. Bull. Brit. Orn. Club., **71** (4): 22.

MEINERTZHAGEN [RICHARD]. 1951. A new race of *Alectoris melanocephala* Rüppell. Bull. Brit. Orn. Club, **71** (5): 29.—*Alectoris melanocephala guichardi* (Raidat es Se'ar, El Hajar, Hadramaut), new subspecies.

MILDENBERGER, HEINZ. 1950. Beiträge zur Oekologie und Brutbiologie des Schwarzkehlchens [*Saxicola torquata rubicola* (L.)]. Bonner Zool. Beitr., **1** (1): 11–20, 2 figs.

MILDENBERGER, HEINZ. 1950. Messungen von Höhe und Geschwindigkeit ziehender Vögel (*Columba palumbus*, *Corvus frugilegus*, *Grus grus*). Bonner Zool. Beitr., **1** (1): 55–57.—Height and speed of flight, with wind directions and wind speeds involved.

MILDENBERGER, HEINZ. 1950. Untersuchungen über die Siedlungsdichte der Vögel in der ackerbaulich genutzten Kulturlandschaft. Bonner Zool. Beitr., **1** (2–4): 221–238, 1 fig., 15 tables.—Ecological study of populations of birds in areas occupied by human beings.

MILLER, ALDEN H. 1951. A comparison of the avifaunas of Santa Cruz and Santa Rosa islands, California. Condor, **53**: 117–123.—Differences in the avifaunas are discussed along with possible factors involved and some systematic discussion. A list of the native terrestrial breeding birds (26 forms) common to the two is given together with miscellaneous records.

MILLER, ALDEN H. 1951. The "rodent-run" of the Green-tailed Towhee. Ibis, **93** (2): 307–308.

MOUNTFORT, G. R., WALTER E. HIGHAM, AND G. K. YEATES. 1951. Studies of some species rarely photographed. XXX. The Great Reed Warbler. Brit. Birds, **44** (6): 195–197.—Six fine photographs of *Acrocephalus arundinaceus* taken in the Camargue, France, with a note on habits by G. R. Mountfort.

MURPHY, ROBERT C. 1951. The populations of the Wedge-tailed Shearwater (*Puffinus pacificus*). Amer. Mus. Novit., No. 1512: 1–21.—A careful analysis of geographical variation in this widespread species of the Pacific and Indian oceans.

The number of races is reduced to two. They are based on size, but the variation is so irregular as not to lend itself readily to the use of racial names. The same is true of the distribution of the white-breasted color phase, which is universal in some breeding colonies and, so far as known, completely absent in others. The sexes are of the same size in this species, though in some congeneric species the male is considerably larger than the female. The annual cycle is outlined for colonies both north and south of the equator.

MURPHY, ROBERT C., AND SUSAN IRVING. 1951. A review of the Frigate-petrels (*Pelagodroma*). Amer. Mus. Novit., No. 1506: 1–17.—The subspecies of *P. marina* have characters correlated with circumpolar climatic zones, not with the relative proximity of the breeding colonies to each other. In most races females are slightly larger than males, an unusual situation among petrels. *Pelagodroma marina albiclunis* is a new subspecies from Sunday Island, Kermadecs.

NEMEC, HELMUT. 1950. Beitrag zur Kenntnis des Trichterlappens der Vogelhypophyse. Österr. Zool. Zeitschr., 2 (4): 352–365, 8 figs.—Brief comparative study of gross structure of avian hypophysis.

NEMEC, HELMUT. 1950. Über das zwischenhypophysere Bindegewebe bei Vögeln und einigen Amphibien. Österr. Zool. Zeitschr., 2 (4): 366–378.—Histological study of glandular structure.

NERO, ROBERT W., AND JOHN T. EMLEN, JR. 1951. An experimental study of territorial behavior in breeding Red-winged Blackbirds. Condor, 53: 105–116.—Nest-moving experiments from mid-May until mid-July in Wisconsin, and interpretations of the nature and maintenance of territorial and social relationships.

ONEY, JOHN. 1951. Fall food habits of the Clapper Rail in Georgia. Journ. Wildl. Manag., 15 (1): 106–107.—669 gizzards of *Rallus longirostris* contained mostly crabs, and one snail.

OWEN, J. H. 1951. Distraction display of Goldfinch [*Carduelis carduelis*]. Brit. Birds, 44 (4): 129–130.

OWEN, J. H. 1951. Distraction display of Chaffinch [*Fringilla coelebs*]. Brit. Birds, 44 (4): 130.

OWEN, J. H. 1951. Display of House Sparrow [*Passer domesticus*]. Brit. Birds, 44 (4): 130–131.

OWEN, J. H. 1951. The flights of the Red-backed Shrike. Brit. Birds, 44 (5): 166–170.—Interesting description of hunting, defense, and mate-searching flights in *Lanius collurio*.

PARKES, KENNETH C. 1951. The genetics of the Golden-winged × Blue-winged Warbler complex. Wilson Bull., 63 (1): 5–15, 1 pl.—The Blue-winged Warbler, *Vermivora pinus*, and Golden-winged Warbler, *V. chrysoptera*, frequently hybridize where their ranges overlap, producing a first generation hybrid, the Brewster's Warbler. The hybrids usually backcross with one or the other parental species. Several kinds of crosses between heterozygous individuals can produce the rare Lawrence's Warbler. The differences between the plumages of the two parent species and the hybrids are explained on the basis of three genes, in two of which there is incomplete dominance and two of which are linked.—J. T. TANNER.

PETRIDES, GEORGE A. 1951. Notes on age determination in juvenal European quail. Journ. Wildl. Manag., 15 (1): 116–117.—Data on *Perdix perdix* and *Alectoris rufa* published by Bureau (1911, 1913) and said to be "virtually inaccessible." The original materials are actually still in print in bulletins sold or exchanged by the Museum of Natural History at Nantes.—J. J. H.

PETRIDES, GEORGE A., AND W. B. DAVIS. 1951. Notes on the birds of Brazos

County, Texas. Condor, **53**: 153–154.—Additional data gathered between 1940 and 1951 to supplement Davis' previous list (Condor, 42: 81–85), 1940.

PINTO, OLIVÉRIO. 1950. Peter Lund e sua Contribuição a Ornitologia Brasileira. Papéis Avulsos, Dept. Zool., Secretaria da Agric., São Paulo, Brasil, **9** (18): 269–283.—Localities and dates between 1825 and 1845.

PINTO, OLIVÉRIO. 1950. Miscelanea Ornitologica, V. Papéis Avulsos, Dept. Zool., Secretaria da Agric., São Paulo, Brasil, **9** (24): 361–365, 1 pl.—*Synallaxis ruficapilla infuscata*, new subsp. (Usina Nossa Senhora do Carmo, Vitória de Santo Antão, eastern Pernambuco, Brasil). Record and photograph of living individual of *Androrhynchus leari* Bonaparte (known until now only from zoo specimens from unknown localities in Brazil) obtained at Joazeiro, on the Rio São Francisco.

PITELKA, FRANK A. 1951. Generic placement of the Rufous-winged Sparrow. Wilson Bull., **63** (1): 47–48.—Reasons are given for placing the species presently named *Aimophila carpalis* in the genus *Spizella*.

POULDING, R. H. 1951. The use of extruded plastic for colour marking. Brit. Birds, **44** (4): 126–127.—For banding young gulls.

PRESTON, F. W. 1951. Egg-laying, incubation, and fledging periods of the Spotted Sandpiper (*Actitis macularia*). Wilson Bull., **63** (1): 43–44.

RAND, R. W. 1951. The guano platforms of South West Africa. Ibis, **93** (2): 309–310.—Large platforms have been erected at Cape Cross and Walvis Bay, South West Africa, to serve as roosting places to attract the large number of sea birds frequenting the coast and to serve as "guano depositories." Cormorants of several species are the most numerous and most valuable "contributors."—J. L. PETERS.

RENSCH, BERNHARD. 1950. Die Abhängigkeit der relativen Sexualdifferenz von der Körpergrosse. Bonner Zool. Beitr., **1** (1): 58–69, 3 figs., 4 tables.—Animals of large size show relatively greater sexual dimorphism than do closely related animals of smaller size.

RICHDALE, L. E. 1951. Banding and marking Penguins. Bird-Banding, **22** (2): 47–54.

ROBBINS, CHANDLER S., PAUL SPRINGER, AND CLARK G. WEBSTER. 1951. Effects of five-year DDT application on breeding bird population. Journ. Wildl. Manag., **15** (2): 213–216.—Annual applications at rate of 2 lbs./acre resulted in 26 per cent decrease in birds of bottomland forest.

ROSICKY, B. 1949–1950. Blechy (Aphaniptera) jako parasiti našich ptáků. Sylvia, **11–12** (3): 61–66.—Summary of records of fleas on the birds of Czechoslovakia—11 species of fleas.

ROWAN, A. N., H. F. I. ELLIOTT, AND M. K. ROWAN. 1951. The "spectacled" form of the Shoemaker *Procellaria aequinoctialis* in the Tristan da Cunha group. Ibis, **93** (2): 169–174, 1 text fig., 1 pl.—A breeding colony of the "*conspicillata*" form of *Procellaria aequinoctialis* was discovered on Inaccessible Island in the Tristan da Cunha group in the early 1920's. The authors visited this colony in mid September and late November, 1949, and in early May, 1950; adult birds were present in the colony on each of these visits, but eggs were found only in November, and the numbers of adults found in May fluctuated with the weather. All the members of the colony were of the "*conspicillata*" type and the variations in head markings are described and illustrated in a text figure.

The nesting habits of the Inaccessible colony differ from those described by Murphy from South Georgia.

Measurements of birds taken on Inaccessible are small (except exposed culmen) compared with those given by Murphy of birds from South Georgia, the South Atlantic, and the coasts of Argentina, Chile, and Perú. The authors conclude that the population of Inaccessible Island is not a color phase but a valid subspecies which should be known as *Procellaria aequinoctialis conspicillata* Gould [see also Southern, Ibis, 93 (2): 174–179, 1951].—J. L. Peters.

Schaub, B. M. 1951. A study of the behavior and population of Pine Siskins [*Spinus pinus*] at Northampton, Mass., February–May, 1947. Bird-Banding, 22 (2): 71–79.

Schüz, Ernst. 1950. Die Frühauflassung ostpreussischer Jungstörche in West-Deutschland durch die Vogelwarte Rossitten 1933–1936. Bonner Zool. Beitr., 1 (2–4): 239–253, 3 figs.—Records of movements of young storks; distances; times involved; directions.

Secker, H. L. 1951. Habits of the Lesser Redpoll [*Carduelis cabaret*] in the Wellington Peninsula. Notornis, 4 (4): 63–66.—Distribution, food, display, habits.

Sharp, Ward M. 1951. Observations on predator-prey relations between wild ducks, Trumpeter Swans and Golden Eagles. Journ. Wildl. Manag., 15 (2): 224–226.—Two *Aquila chrysaëtos* occasionally killed young *Cygnus buccinator* and found *Glaucionetta clangula* and *G. islandica* easy to capture in mid-air. Their stoops at *Anas platyrhynchos* were less successful. They seemed unable to take ducks from water.

Shelford, V. E. 1951. Fluctuation of non-forest animal populations in the Upper Mississippi basin. Ecol. Monog., 21 (2): 149–181.—Deals chiefly with chinch bugs and other insects but includes analysis of annual fluctuations of Bob-white populations in Wisconsin, Ohio, and Illinois in relation to weather. Good correlations are shown with solar ultraviolet and rainfall during the sensitive mating period of April.—S. C. K.

Simmons, K. E. L. 1951. Distraction-display in the Kentish Plover. Brit. Birds, 44 (6): 181–187.—Mobile and static lure-displays and displacement-activities were studied in six pairs of *Leucopolius alexandrinus* nesting in Egypt. Three sketches.

Singleton, J. R. 1951. Production and utilization of waterfowl food plants on the East Texas Gulf Coast. Journ. Wildl. Manag., 15 (1): 46–56.—Interesting yield data on various food plants. A change in food habits (from that reported by Martin and Uhler) is pointed out, natural foods being less used by ducks in favor of rice. Drainage now threatens this important winter range.

Skead, C. J. 1950. A study of the Black-collared Barbet, *Lybius torquatus*, with notes on its parasitism by the Lesser Honeyguide, *Indicator minor*. Ostrich, 21: 84–96.

Skutch, Alexander F. 1951. Life history of Longuemare's Hermit Hummingbird. Ibis, 93 (2): 180–194.—*Phaethornis longuemareus saturatus* is a rather common resident of the humid tropical zone of Central America. Food consists primarily of nectar and small insects from the corollas of flowers and, in the instances of flowers with long and slender corolla tubes, the bird actually perforates the tissue of the tube with its bill to reach the nectar. The male takes no part either in nest-building or in the care of eggs and young, but a number of males gather at a "courtship assembly" point where they make known their position to the females by singing. The nest is placed beneath the drooping end of a leaf (usually a palm frond) and is composed of plant down, scales from tree-fern, shreds of inner bark, fragments of fern-fronds, and a few tufts of green moss, the whole

not only bound together with cobweb but also attached to the leaf with this material. There appear to be two nesting periods annually, the first beginning in April, the second in November; incubation is from 15–16 days; nestling period 20–21 days; and nesting success probably less than 33 per cent.—J. L. PETERS.

SMITH, K. D. 1951. The behaviour of some birds on the British list in their winter quarters or on migration in Southern Rhodesia. Brit. Birds, **44** (4): 113–117.

SMITH, K. D. 1951. On the birds of Eritrea. Ibis, **93** (2): 201–233.—An account of Eritrea, its physiography, climate, and bird life based on six years' residence. The country is divided into four areas: (1) the Highland Plateau or Altopiano; (2) The Plateau slopes; (3) the inland regions at low altitudes which are further subdivided into the Western Plain or Bassopiano Occidentale, the Eastern Plain or Bassopiano Orientale, and the volcanic region of Dancalia, one of the hottest places in the world; and (4) the coast and islands. Characteristic species comprising the "bird communities" of the four areas are listed and arranged according to their diets. There are also notes on migrants (but no dates) and winter visitors.—J. L. PETERS.

SORENSEN, J. H. 1950. The Light-mantled Sooty Albatross at Campbell Island. Sci. Results New Zealand Sub-Antarctic Exped., 1941–45. Cape Expedition Series Bull. No. 8: 1–30.—*Phoebetria palpebrata*. This report is the result of studies extending over the greater part of five years. All phases of the life history are covered: arrival and courtship, nests and eggs, incubation, behaviour, chicks from hatching to flight. There are 12 excellent photographs and a graph. The first birds were seen early in October. The construction of the nests commences towards the end of the month, the females doing most of the work. Each season a new nest is made, sometimes quite close to the old one. In 1942 the first egg was found on October 31. The incubation period is 63–67 days. Most chicks are hatched between January 3 and 6, and they leave the nests in May when 20 weeks old.—W. R. B. OLIVER.

SOUTHERN, H. N. 1951. Addendum: the status of *Procellaria conspicillata*. Ibis, **93** (2): 174–179.—A discussion of the possible type-locality of *conspicillata*, resume of observations of this form and *aequinoctialis*, speculation on former range of *conspicillata*, and lastly the conclusion that "rare spectacled birds may well turn up at other colonies, and, if their wing measurements fall within the range of normal *aequinoctialis*, it would strengthen the probability that a small gene-frequency for this character exists all over the range, and that at Inaccessible the wild-type allelomorph has been replaced, while at the same time a shorter-winged subspecies has been evolved." This conclusion leads the reviewer to suggest the desirability of a reexamination of the type of *Procellaria conspicillata* in the Academy of Natural Sciences of Philadelphia with the view of finding how its measurements compare with those of *P. aequinoctialis* on the one hand and those of the Inaccessible Island population on the other. [see also Rowan, Elliott, and Rowan, Ibis, 93 (2): 169–174, 1951].—J. L. PETERS.

STEINPARZ, KARL. 1950. Die Stauseen in Oberösterreich und ihre Auswirkungen auf die Vogelwelt. Bonner Zool. Beitr., **1** (2–4): 215–220.

STORR, G. M. 1951. Display in Sharp-tailed Sandpipers. Emu, **50** (4): 284–285.

STRESEMANN, ERWIN. 1950. Die brasilianischen Vogelsammlungen des Grafen von Hoffmannsegg aus den Jahren 1800–1812. Bonner Zool. Beitr., **1** (1): 43–51.

STRESEMANN, ERWIN. 1950. Die brasilianischen Vogelsammlungen des Grafen von Hoffmannsegg aus den Jahren 1800–1812. Bonner Zool. Beitr., **1** (2–4): 126–143.—Consists primarily of taxonomic equivalents of old nomenclature.

SUTTON, GEORGE MIKSCH. 1951. Subspecific status of the green jays of northeastern Mexico and southern Texas. Condor, **53**: 124–128.—*Xanthoura yncas glaucescens* Ridgway is a synonym of *X. y. luxuosa* (Lesson).

TARR, HAROLD E. 1951. Sea birds in Port Phillip Bay during stormy weather. Emu, **50** (4): 284.

TIMMERMANN, G. 1951. Investigations on some Ischnoceran bird lice (Genus Saemundssonia) parasitic on waders. Annals and Mag. Nat. Hist. (12), **4** (4): 390–401.

TOSCHI, AUGUSTO. 1950. Sulla biologia del *Lanius collaris humeralis* Stanley. [Field notes and studies on the East African fiscal.] Lab. di zoologia applicata alla caccia, Univ. Bologna, **2** (4): 65–136.—An intensive study of the life history and particularly the reproduction of this shrike. With English summary and subtitles for tables and graphs.

TUCKER, B. W. 1951. [Obituary of]. Ibis, **93** (2): 300–305, portrait.

VAN BENEDIN, A., AND J. S. HUXLEY. 1951. The aerial dawn chorus of the swallow. Brit. Birds, **44** (4): 127–128.—Before-dawn chorus of *Hirundo rustica* in the fall at Liège and in May in England.

VERHEYEN, RENÉ. 1950. Sur la portée pratique du "Cline" en ornithologie systématique. Bull. Inst. Royal Sci. Nat. Belgique, **26** (60): 1–10.

VLEUGEL, V. A. 1951. A case of Herring Gulls learning by experience to feed after the explosion of mines. Brit. Birds, **44** (5): 180.—In 1947 large numbers of *Larus argentatus* came to feed upon dead fish immediately after the explosion of mines by the Royal Dutch Navy.

WETMORE, ALEXANDER. 1951. The original description of the fossil bird Cryptornis antiquus. Condor, **53**: 153.—Lambrecht's standard reference on fossil birds lists the species as *Cryptornis antiquus* Milne-Edwards, whereas it should be *Cryptornis antiquus* (Gervais).

WILKINSON, A. DENBY. 1951. Hirundines following tractor and taking moths. Brit. Birds, **44** (6): 204.—On Sept. 23, 1950, Barn Swallows (*Hirundo rustica*), House-Martins (*Delichon urbica*) and Bank Swallows (*Riparia riparia*) followed a tractor and caught Silver Y moths (*Plusia gamma*).

WILLIAMSON, KENNETH. 1951. Fair Isle Bird Observatory. Notes on selected species, Autumn, 1950. Brit. Birds, **44** (4): 117–122.

WILLIAMSON, KENNETH. 1951. Aposematic behaviour of Snipe and Woodcock on being trapped. Ibis, **93** (2): 306–307.

WOLTERS, H. E. 1950. Über einige Gattungen der *Estrildinae*. Bonner Zool. Beitr., **1** (1): 31–38, 2 figs.—Primarily phylogenetic.

OBITUARIES

WILLIAM BONAR BELL, an Associate Member of the American Ornithologists' Union, elected in 1912, died of a heart attack on March 30, 1949, in Washington, D. C., at the age of 71.

Dr. Bell, born in Milton, Iowa, June 2, 1877, completed work at the University of Iowa with A.B., M.S., and Ph.D. degrees. He studied later at Woods Hole, Massachusetts, and at the Smithsonian Table, Zoological Station, at Naples, Italy.

He joined the Biological Survey in 1916 as assistant to Dr. A. K. Fisher in supervising rodent and predatory animal work, largely in the western states.

In 1927 he was made head of the Division of Biological Investigations, and when in 1935 all research work in the bureau was consolidated, he became chief of the new Division of Wildlife Research, remaining in that position until his retirement in 1944.

Under his leadership many new research activities were initiated, the most important being the cooperative wildlife research program with state agricultural colleges and state game departments. These units, in addition to initiating many studies, quickly became the major training schools for wildlife workers needed in the expanding wildlife management field.

Prior to joining the Fish and Wildlife Service, he was for many years at the North Dakota Agricultural College, first as a professor of biology, and later as a professor of zoology and physiology, a position he left to enter the Biological Survey.

During that period he cooperated with the Biological Survey in a survey of birds and mammals in North Dakota.

Despite the fact that Dr. Bell's service with the Biological Survey (now the Fish and Wildlife Service) was always in administrative positions, he never lost his early interest in birds and mammals and found time to write many papers and biological reports on life histories, habits, and management.—IRA N. GABRIELSON.

CHARLES KNAPP CARPENTER, an Honorary Life Associate, joined the A. O. U. in 1894. Death occurred in a hospital at Freeport, Illinois, December 24, 1948. He was born at Baileyville, Illinois, March 19, 1872. Here he resided during the last years of his life. Rev. Carpenter was graduated from Mt. Morris College in 1889, and in 1896 received a Ph.D. from the University of Michigan. It was his original plan to follow science as a career, but he entered the ministry. Pastorates were held at Pecatonica, Polo, Aurora, Elgin, Oak Park, Ravenswood, Chicago, Morgan Park, and Wheaton. Previous to retirement in 1940, he served for six years as superintendent of the Rockford district of the Methodist Church.

Retaining a keen interest in natural history, he maintained a private museum of specimens that he mounted with natural surroundings. Much of his time following retirement was spent watching birds in the woods north of his home. He was a member of the American Association for the Advancement of Science, and a charter member of the Illinois State Academy of Science. A book, 'The early history of Northern Illinois,' was published posthumously.—A. W. SCHORGER.

EDWARD RUSSELL FORD, elected an Associate of the American Ornithologists' Union in 1920 and a member in 1936, died in Winnetka, Illinois, on January 13, 1951. He had not been in good health for several years, but he had been more or less active until a few months before his death. He was born in Malden, Massachusetts, December 27, 1875, but he spent the larger portion of his life in Chicago. In recent years, he had lived in Newaygo, Michigan, except for winters in Florida, and in southern Texas.

Ford had an early interest in ornithology, and he was able to give most of his time to it after retiring from the publishing business in 1928. He was Honorary Curator of Oology at the Chicago Academy of Sciences, 1931 to 1933, after which he was Honorary Curator of Ornithology. He did much in organizing the collections of birds and birds' eggs at the Academy.

Ford was a fine field ornithologist and a good companion. He wrote a number of articles for the 'Audubon Bulletin' and for the 'Chicago Naturalist.' He is best known as the senior author of the list of birds of the Chicago region published in 1934 with Sanborn and Coursen by the Chicago Academy of Sciences. He had finished his part of a new edition of this work now in press.

In addition to his ornithological publications, Ford was a contributor for some years of humorous items to the column "A Line O' Type or Two" in the Chicago Tribune, and he wrote some poetry.

Ford was editor of the 'Inland Bird Banding News,' 1931–1938, and he was secretary of the Inland Bird Banding Association during that period. He was also a member of the editorial committee of the 'Audubon Bulletin,' 1933–1946. During this period, he was a member of the Board of Directors of the Illinois Audubon Society, after which he was an Honorary Director. Ford was also a member of the Wilson Ornithological Club, the Michigan Audubon Society, the Chicago Ornithological Society, (secretary, 1914, and president, 1918), and of the Kenicott Club of Chicago. —R. M. STRONG.

ALBERT JOSEPH BERNARD KIRN, elected an associate of the A. O. U. in 1918 and becoming a Life Associate in 1920, died in San Antonio, Texas, on October 1, 1950. He was born on October 5, 1885, in Paxico (Newberry), Kansas. The latter part of his life was spent in Texas where he was engaged in agriculture and the petroleum industry. He was greatly interested in insects and birds, and published 'Nesting birds, Copan, Washington County, Okla.' (Oologist, 33: 203–4, 1916). Several notes by him on birds appeared in the 'Oologist' between 1915 and 1918. An incomplete manuscript on the birds of Texas, as well as his collections, is deposited in St. Mary's University, San Antonio. Beginning in 1946, he was a special lecturer in zoology at this institution.—A. W. SCHORGER.

CECIL BODEN KLOSS, elected a Corresponding Fellow of the A. O. U. in 1918, died in Lymington, Hampshire, England, on August 19, 1949. He was born in Worcestershire, England, on March 28, 1877. Following retirement as Director of the Museums of Strait Settlements and Federated Malay States in 1936, he lived in England. Kloss was noted for his extensive explorations at high altitudes in New Guinea, Java, Malaya, Borneo, Sumatra, Indo-China, and Siam. He described nearly 100 species and subspecies in 50 papers that appeared between 1920 and 1932, principally in the 'Journal Natural History Society Siam,' 'Journal Federated Malay Museum,' 'Journal Malayan Branch Royal Asiatic Society Singapore,' 'Bulletin Raffles Museum Singapore,' 'Treubia Buitenzorg,' and 'Bulletin British Ornithological Club.' His name is attached to such forms as *Pycnonotus cafer klossi*, *Spilornis minimus klossi*, *Rallicula rubra klossi*, *Bubo coromandus klossii*, and *Harpactes erythrocephalus klossi*.—A. W. SCHORGER.

PAWEL (PAVELL) PATEFF, a Corresponding Fellow of the A. O. U., elected in 1934, died on March 22, 1950. He was born in Plovdiv, Bulgaria, in 1889. His education was received at Sofia University. Until 1928, except for service in World War I, he was interested mainly in protozoology and plant pathology. The turning point

in his career was an appointment to the Museum of Natural History in Sofia, where he was in charge of the department of ornithology. In 1930 he was attached to the Zoological Gardens, Sofia, of which he later became Director. He collected extensively in Bulgaria and was interested in banding and economic ornithology.

Most of Pateff's papers were written in German. Those relating to banding appeared in 'Bull. Inst. Roy. Hist. Nat. Sofia.' Notes were furnished by him to the paper by J. M. Harrison, 'A contribution to the ornithology of Bulgaria' (Ibis (13) **3**: 494–521, 589–611, 1933). Two papers of special importance were: 'Die geographische Verbreitung der Vögel in Bulgrien,' (C. R. 9me Cong. Orn. Intern. Rouen, 257–265, 1938, and 'On the systematic position of the starlings inhabiting Bulgaria and the neighboring countries' (Ibis, **89**: 494–507, 1947) in which six principal subdivisions were recognized. A manuscript of a book on the birds of Bulgaria was ready for the press at the time of his death.

The following tribute was paid him by J. M. Harrison (Ibis, **75**: 495, 1933) following his field work in Bulgaria: "Philosopher, guide, interpreter, and friend, without whose practical help we could have accomplished nothing, his extensive and intimate knowledge of the country, more particularly from the ornithological viewpoint, proved of the greatest help to us."—A. W. Schorger.

William Pepper Jr., an Associate of the American Ornithologists' Union, elected in 1930, died in Philadelphia, Pennsylvania, December 3, 1947, at the age of 73. He was born in Philadelphia, May 14, 1874, and was the third William Pepper connected with the University of Pennsylvania. He graduated from the College of Arts and Sciences in 1894, from the School of Medicine in 1897. A year later he began the practice of medicine with his father, William Pepper. In 1899 he was appointed assistant instructor in clinical medicine, later instructor and assistant professor of pathology, in 1912 dean, and from this position he retired in 1945 as dean emeritus.

During World War I he served as Lieutenant Colonel in the Army Medical Corps and as Commanding Officer of Base Hospital 74. His Honorary degrees included D.Sc. from his alma mater and LL.D. from Temple University. He was a Trustee of the University of Pennsylvania and the Free Library of Philadelphia, a Fellow of the College of Physicians and a Member of the Association of Pathologists and Bacteriologists, a member of the Council on Medical Education of the American Medical Association and, in 1920–21, president of the Association of American Medical Colleges.—T. S. Palmer.

Elizabeth Russell Vaughan (Mrs. Henry G. Vaughan), elected an Associate of the American Ornithologists' Union in 1948, died at South Berwick, Maine, on October 6, 1949. She was born in Boston on April 2, 1871. Mrs. Vaughan was deeply interested in the preservation of birds, flora, and historical places. She gave generously to the Save the Redwoods League, Society for the Preservation of New England Antiquities, National Audubon Society, Maine Audubon Society, and served on several of their boards. At her country places at Sherborn, Massachusetts, and South Berwick, Maine, feeding stations were maintained and every effort made to render the places attractive to birds. The woods on the estate at South Berwick, maintained in a natural state, was left to the state of Maine with a fund to maintain it as a wildlife sanctuary. She was buried in Mount Auburn Cemetery, Cambridge, Massachusetts. Surviving her are two brothers, George Tyson, Newport, Rhode Island, and Russell Tyson, Chicago, Illinois.—A. W. Schorger.

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